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Colson et al.

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(54) **VANE FOR AN ARCHITECTURAL COVERING**

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(*) Notice: Under 35 U.S.C. 154(b), the term of this
patent shall be extended for 0 days.

This patent is subject to a terminal dis-
claimer.

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(21) Appl. No.: **09/256,129**

(22) Filed: **Feb. 24, 1999**

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1997, which is a continuation of application No. 08/437,959,
filed on May 10, 1995, now abandoned.

(51) **Int. Cl.⁷** **E06B 9/36**

(52) **U.S. Cl.** **160/168.1 V; 160/236**

(58) **Field of Search** 160/236, 900,
160/330, 348, 168.1 V, 176.1 V, 84.05,
84.01, 176.1 R, 168.1 R

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Primary Examiner—Blair M. Johnson

(74) *Attorney, Agent, or Firm*—Dorsey & Whitney LLP

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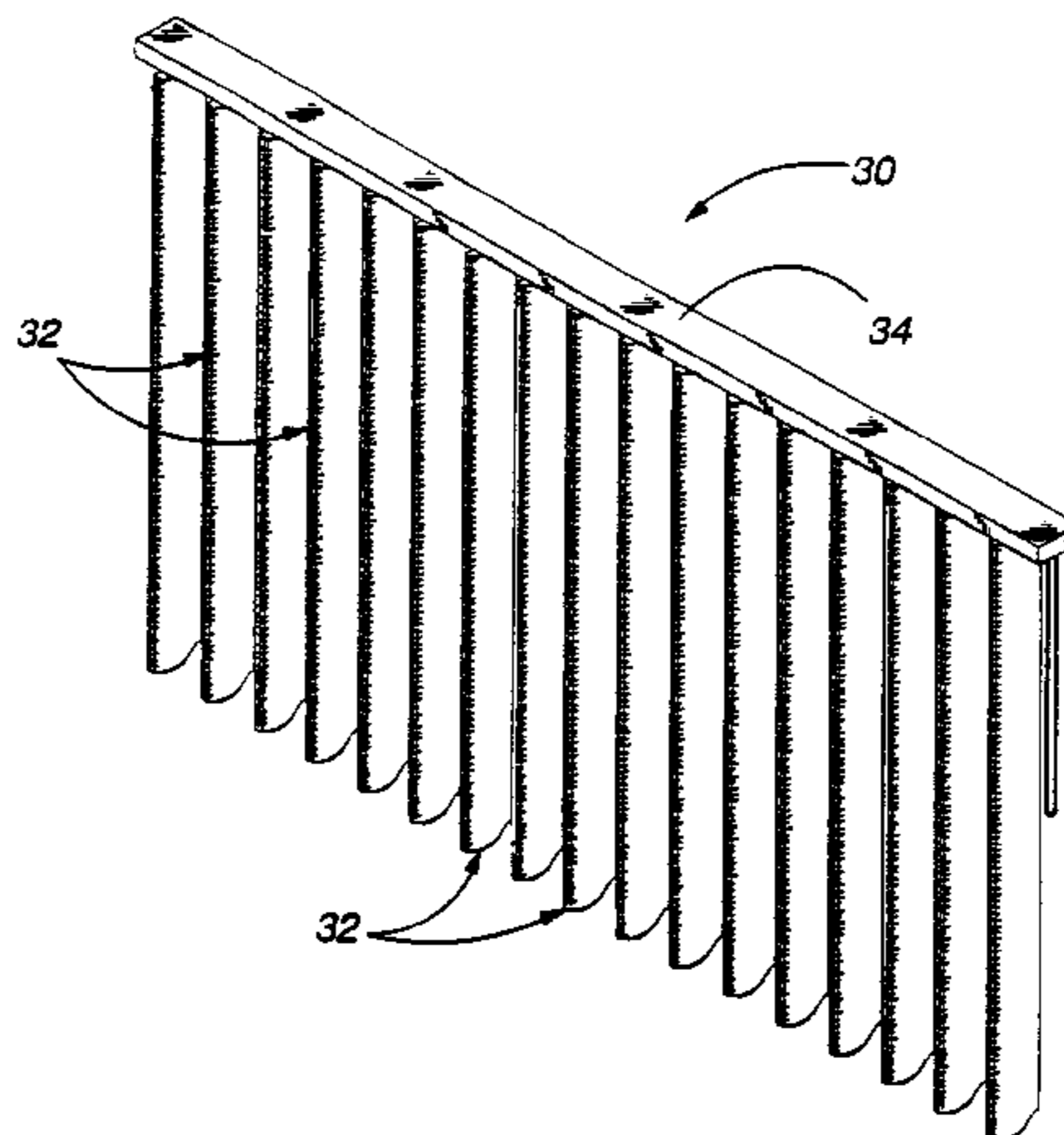
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(57) **ABSTRACT**

A vane for an architectural covering, such as of the type used in a window opening, is designed for vertical suspension so as to resist twisting along its length. The vane is constructed in a tubular configuration and may have one or more internal hollow cells. The external configuration of the vane may simulate an air foil or have other related configurations. The vanes are preferably made of a material having diagonal, dimensional stability or memory, i.e. the ability to resist stretching in a direction diagonal to the length or width of the material.

35 Claims, 11 Drawing Sheets



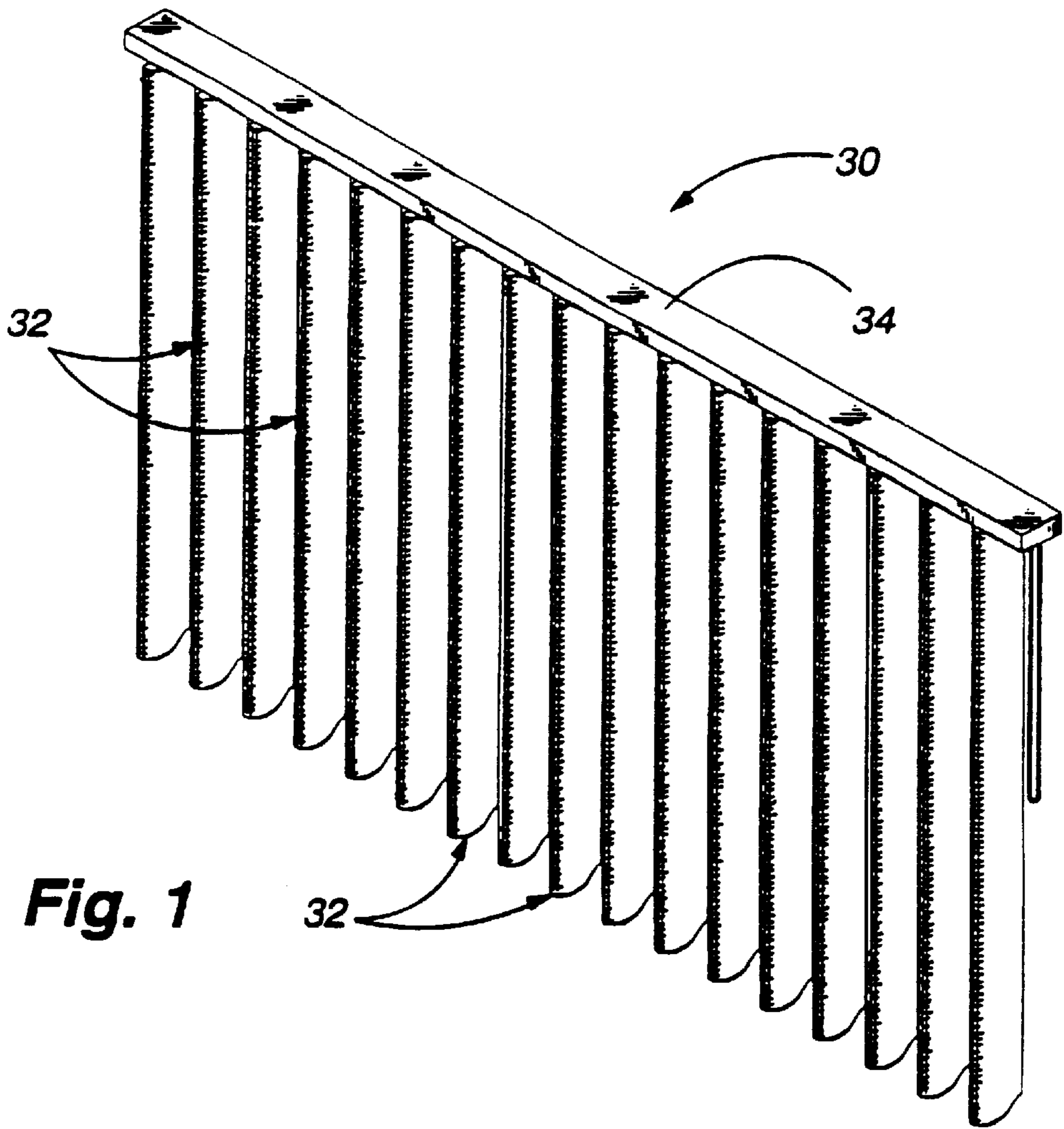


Fig. 1

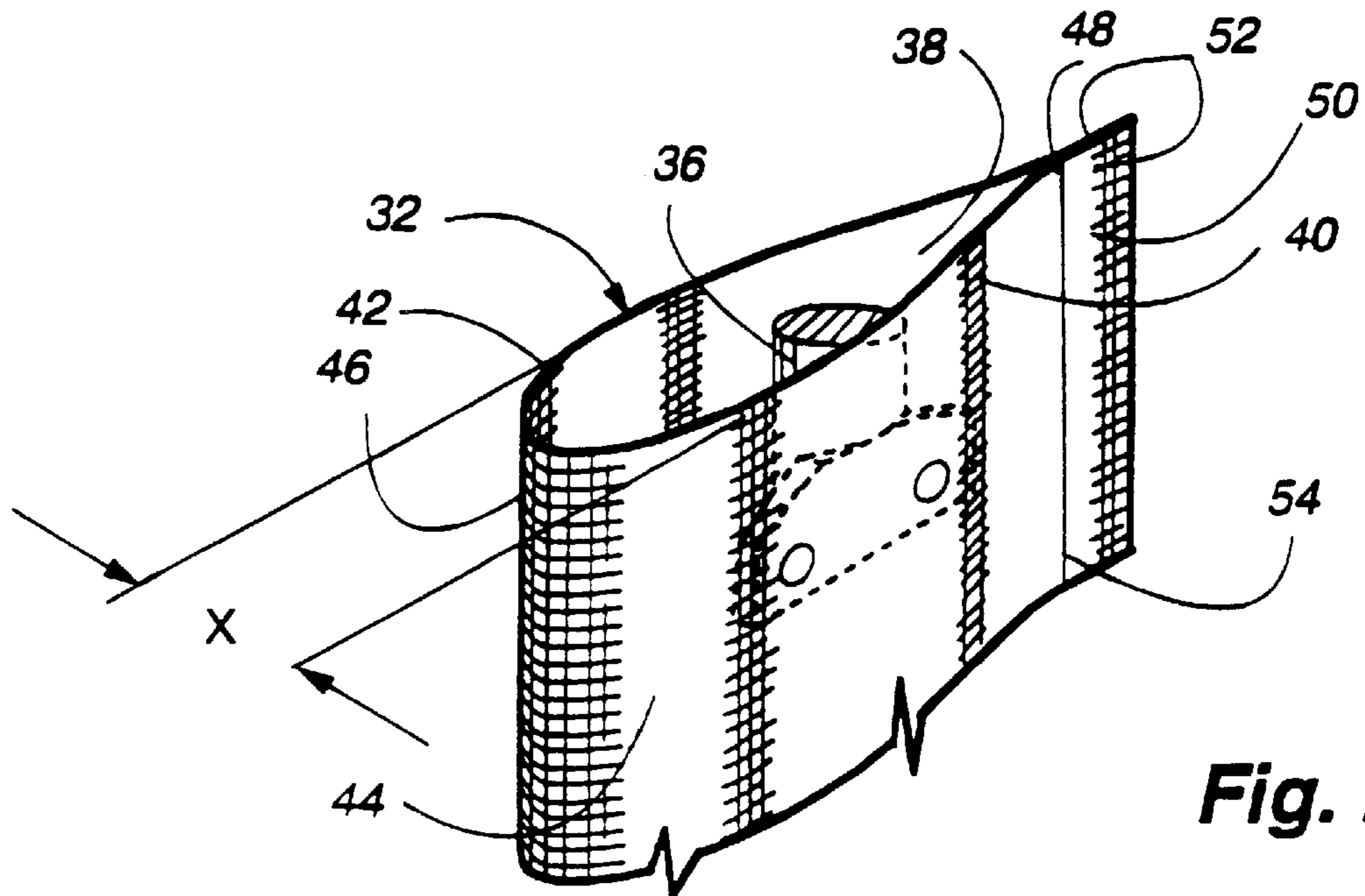


Fig. 2

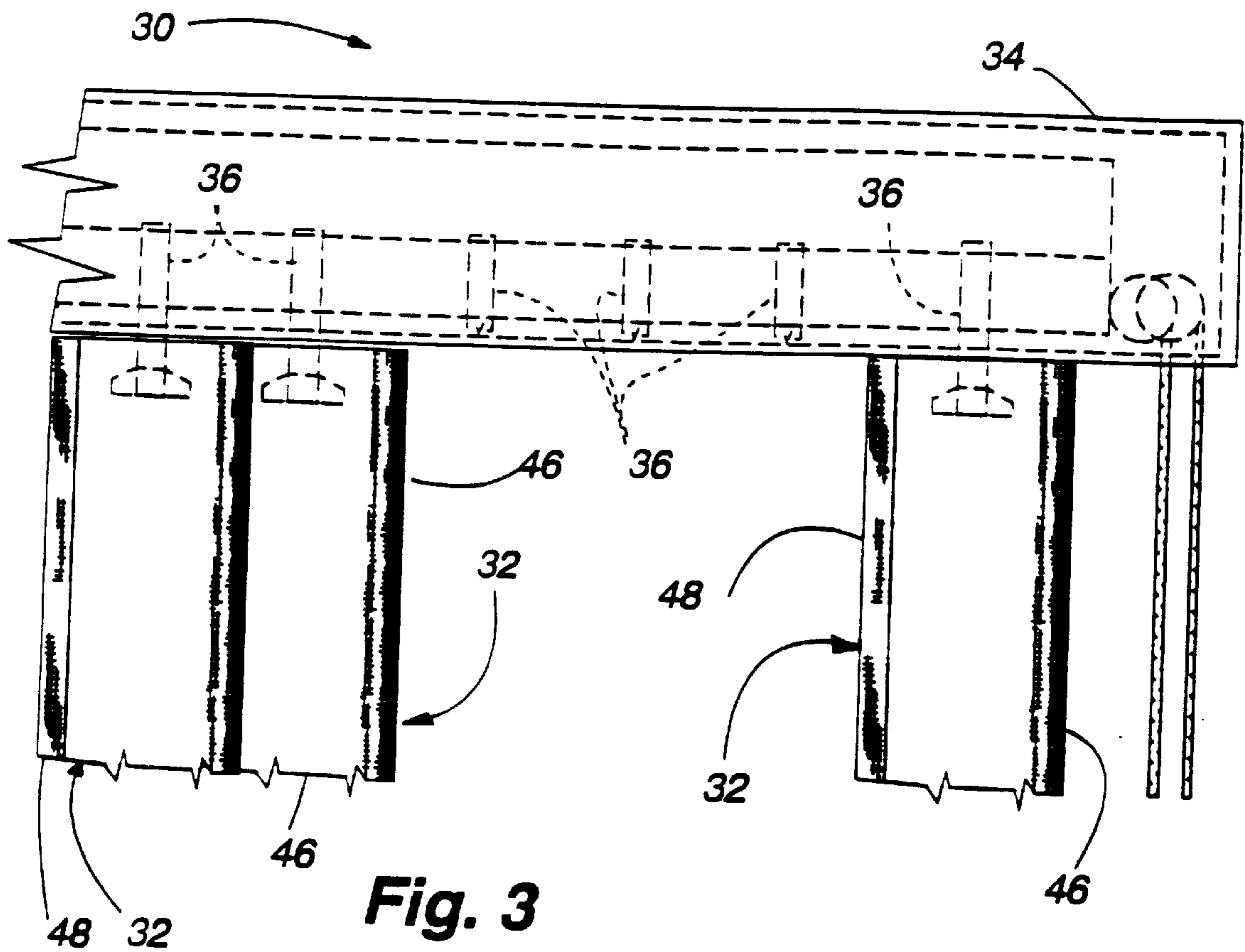


Fig. 3

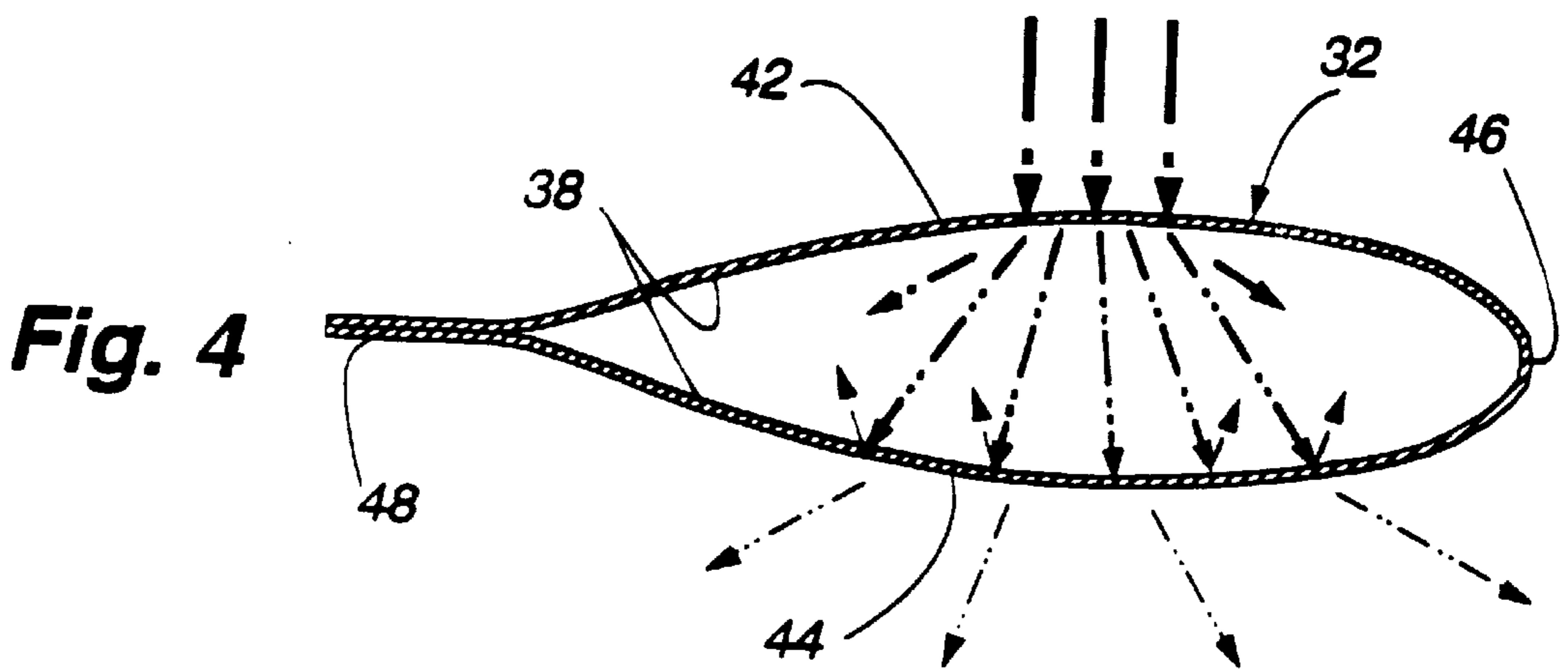


Fig. 4

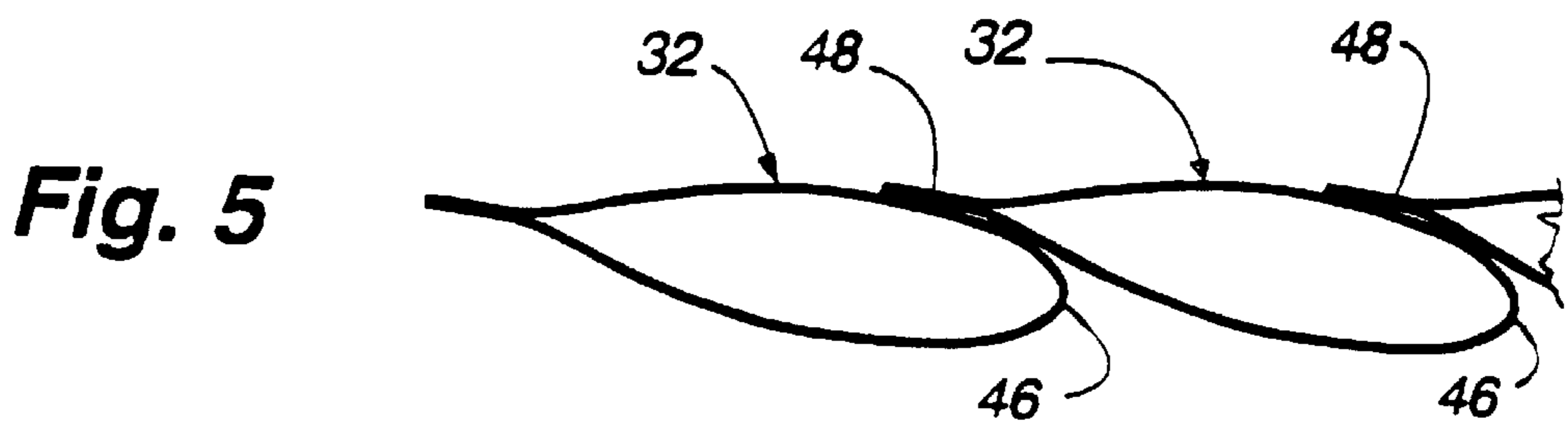


Fig. 5

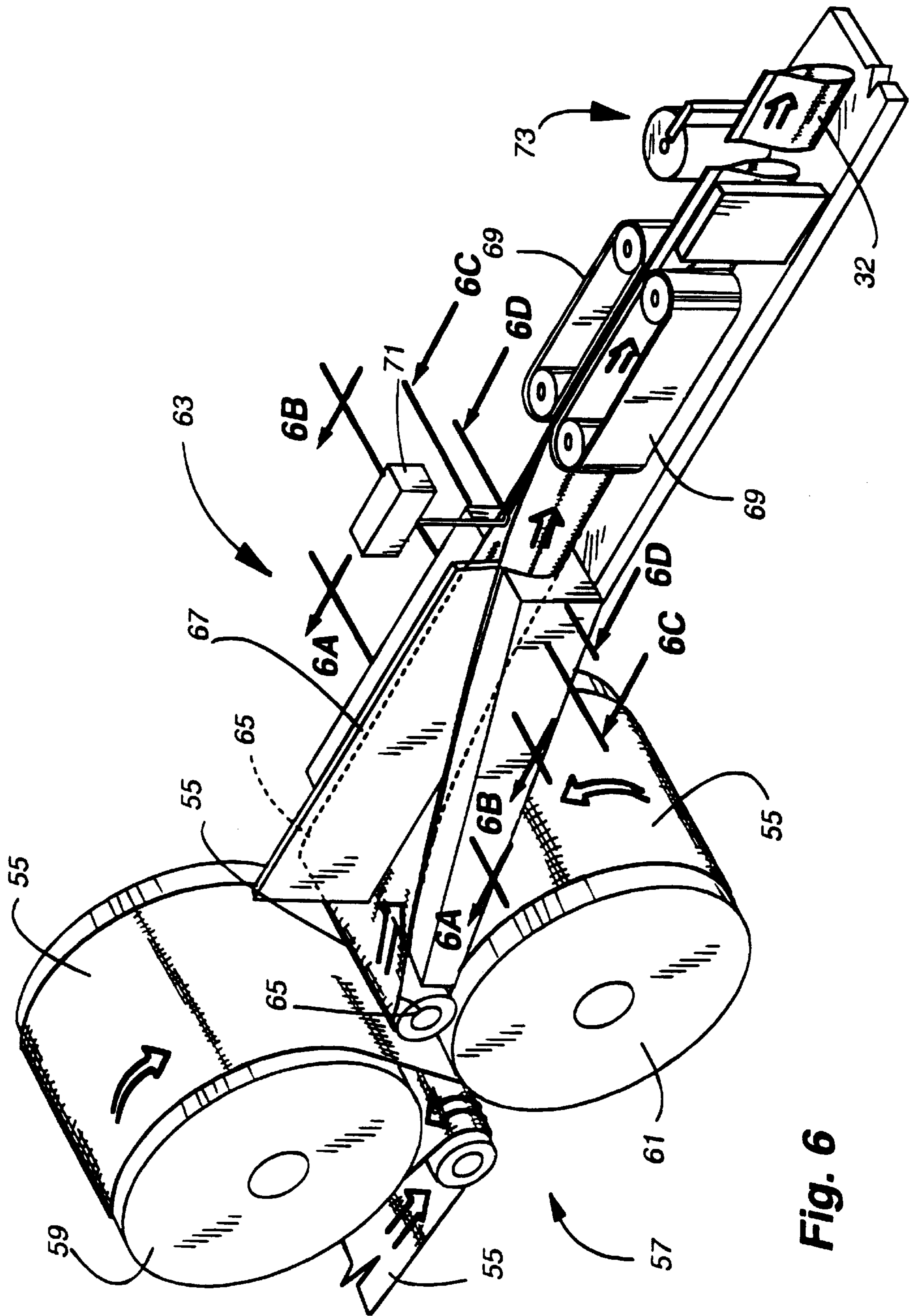
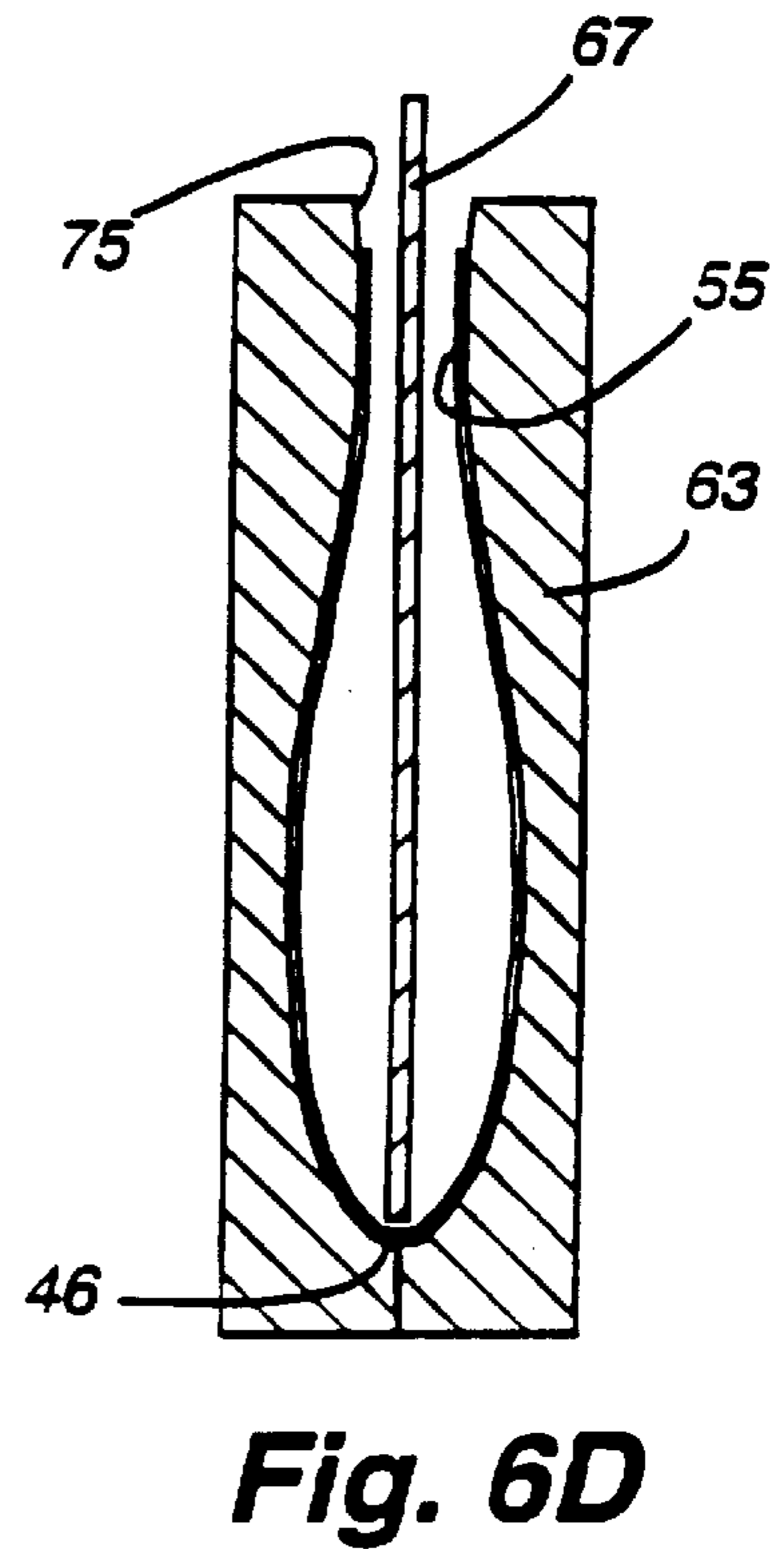
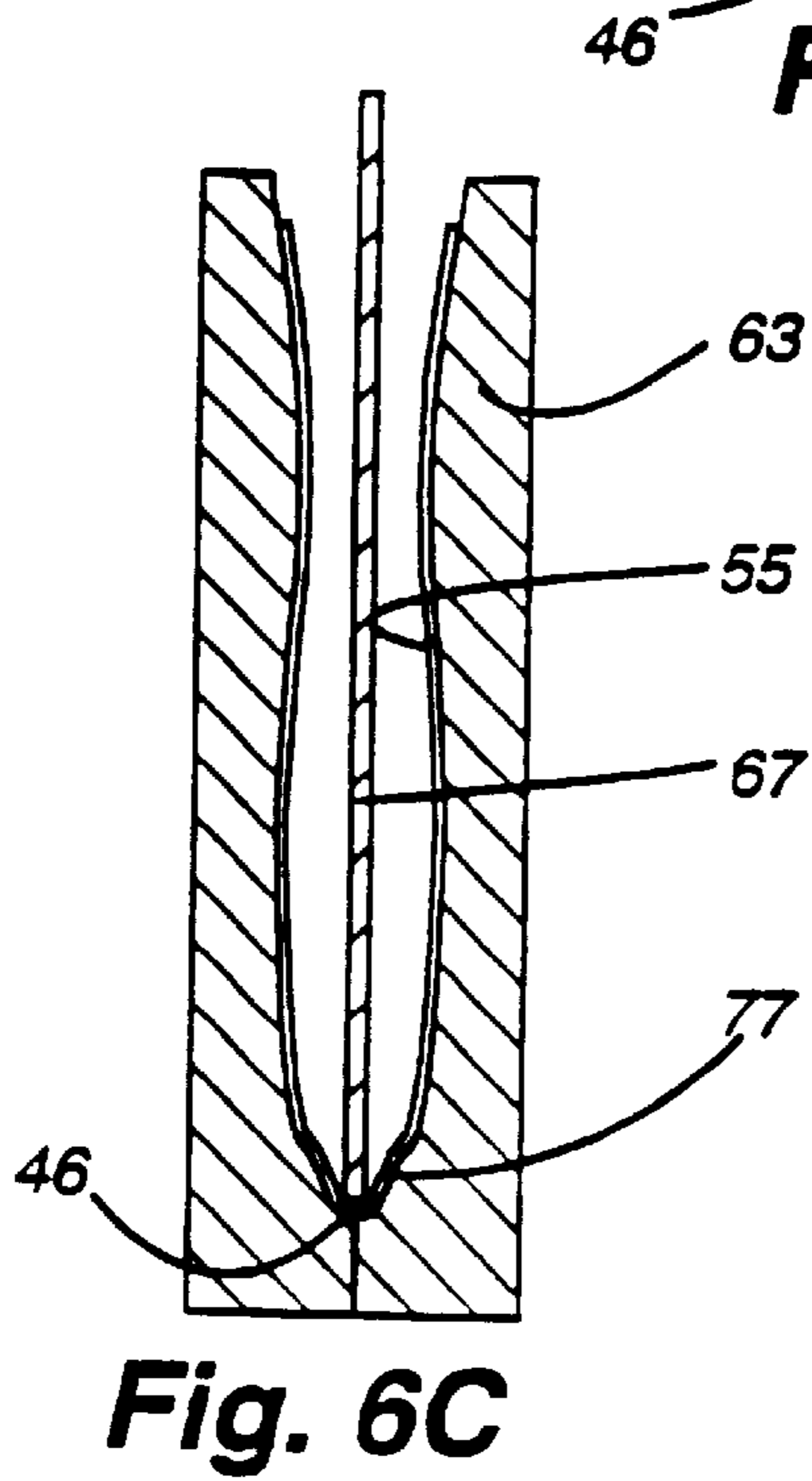
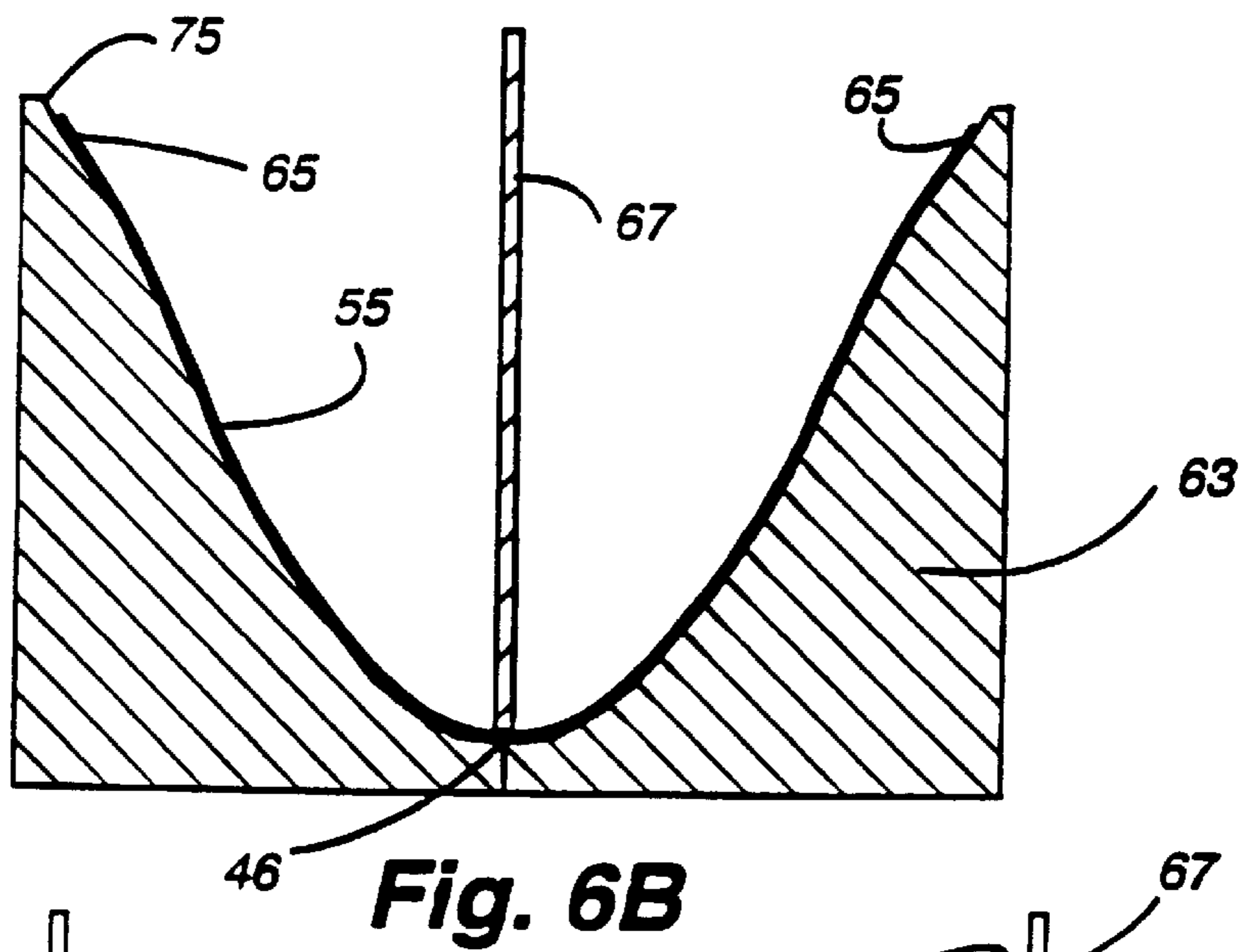
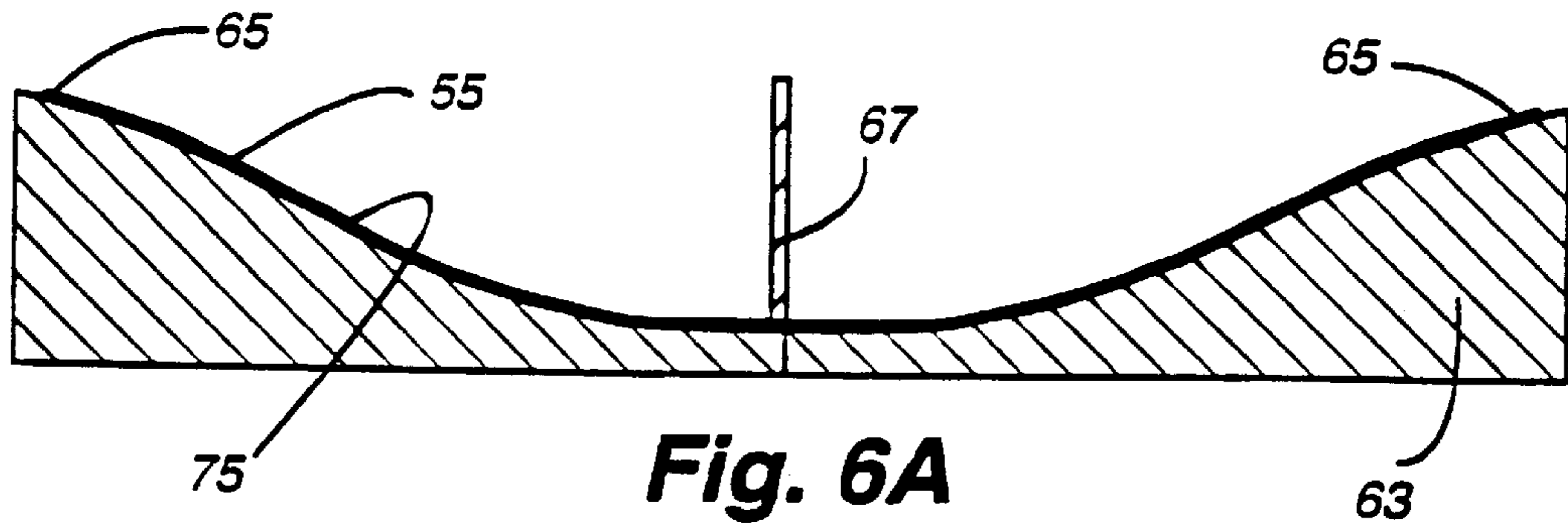


Fig. 6



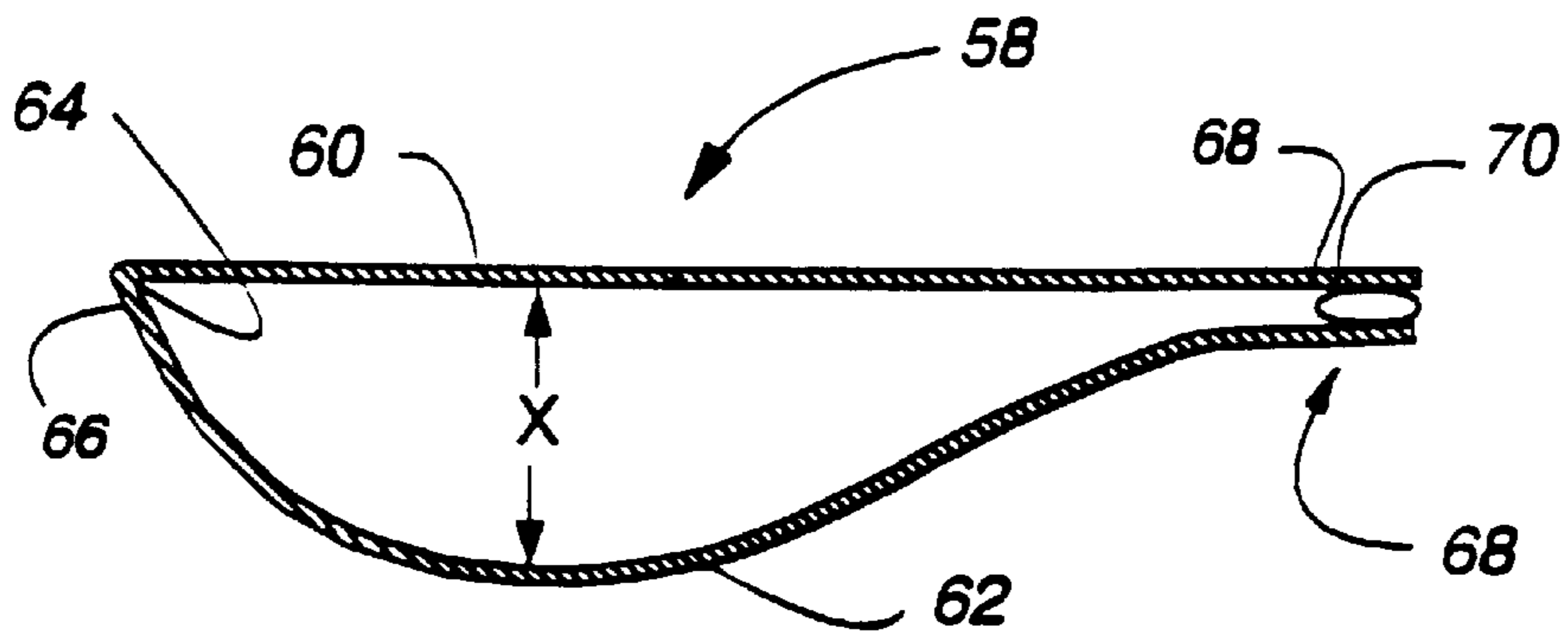


FIG. 7



FIG. 8

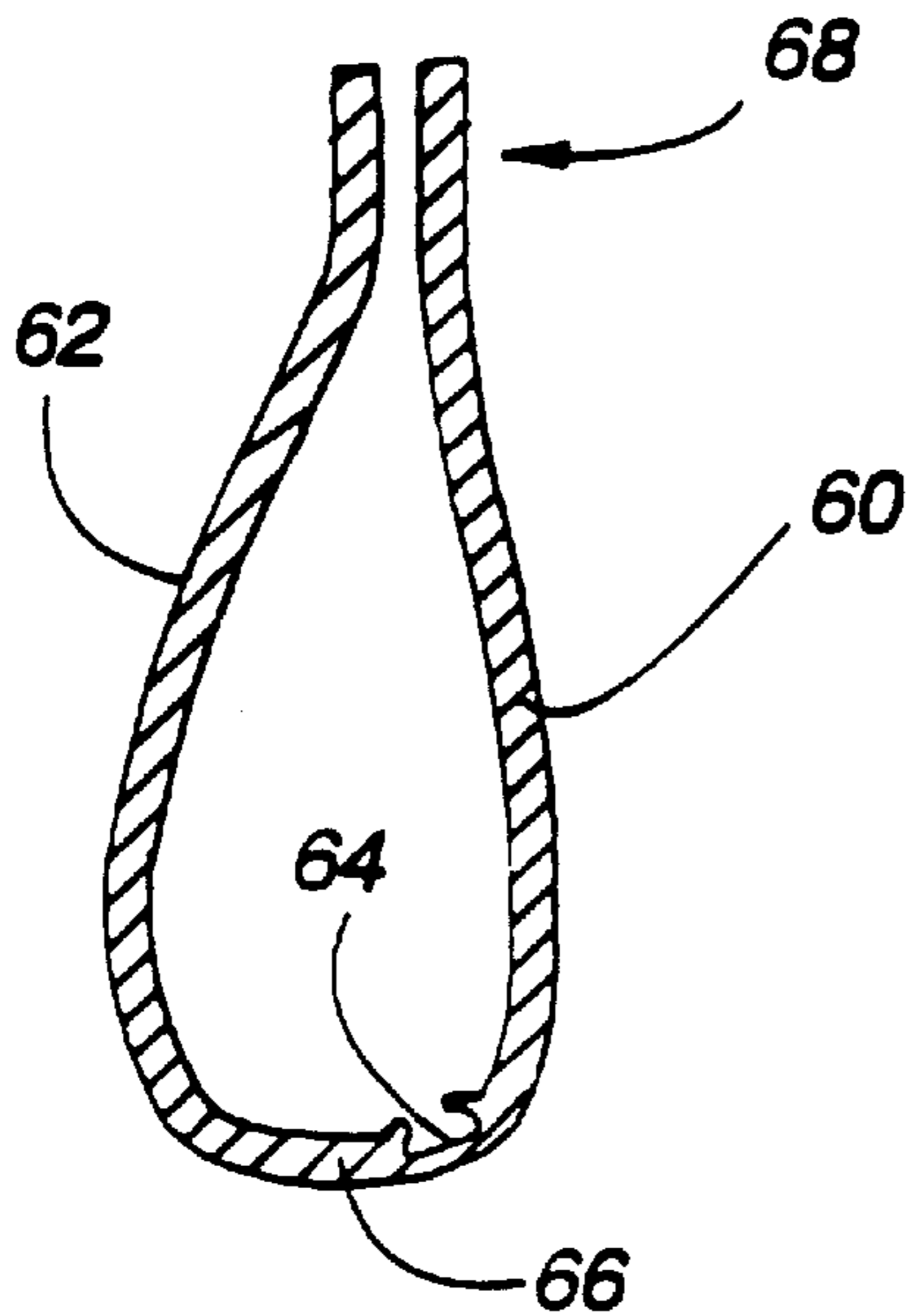


FIG. 9

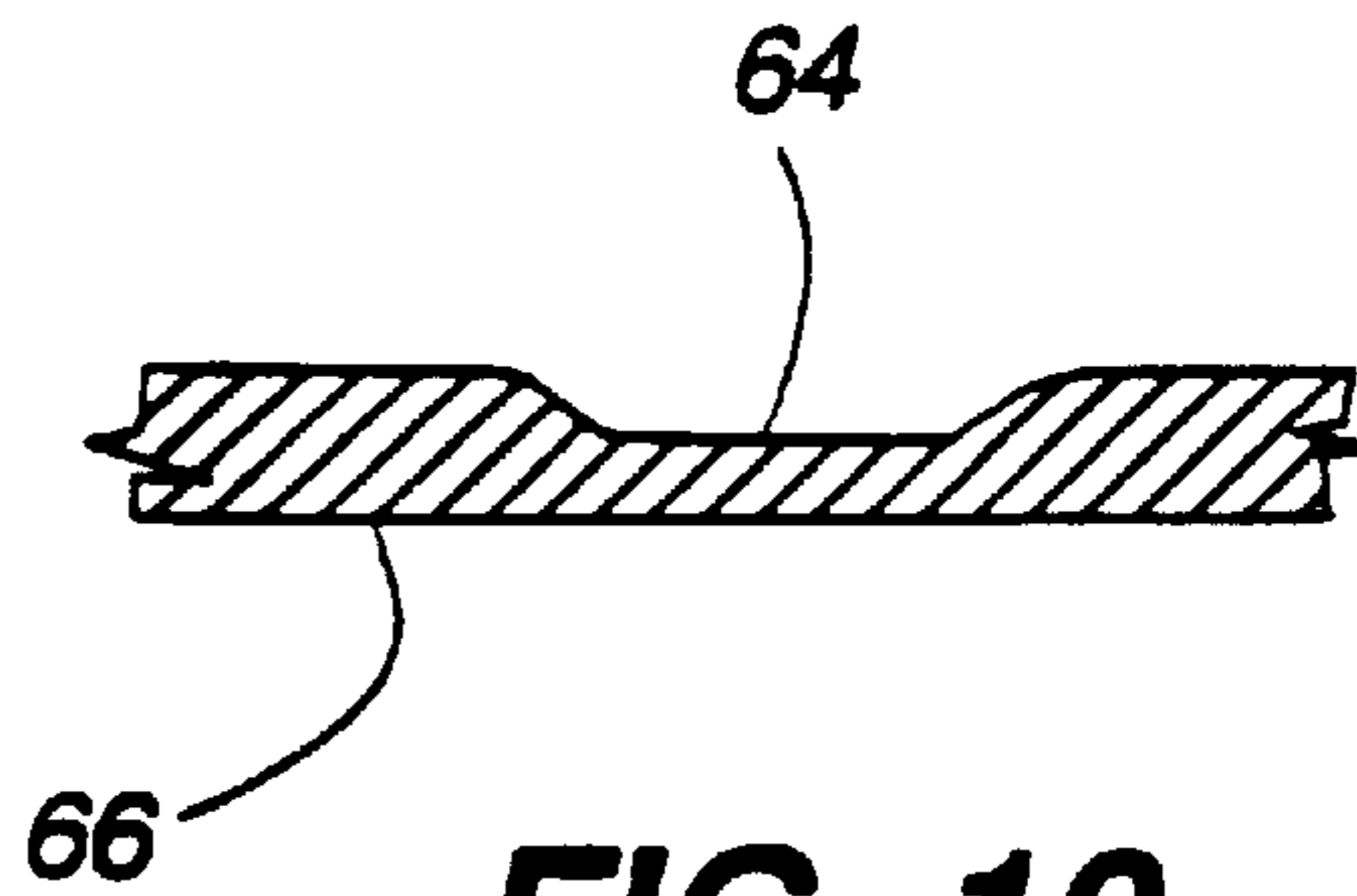


FIG. 10



Fig. 11

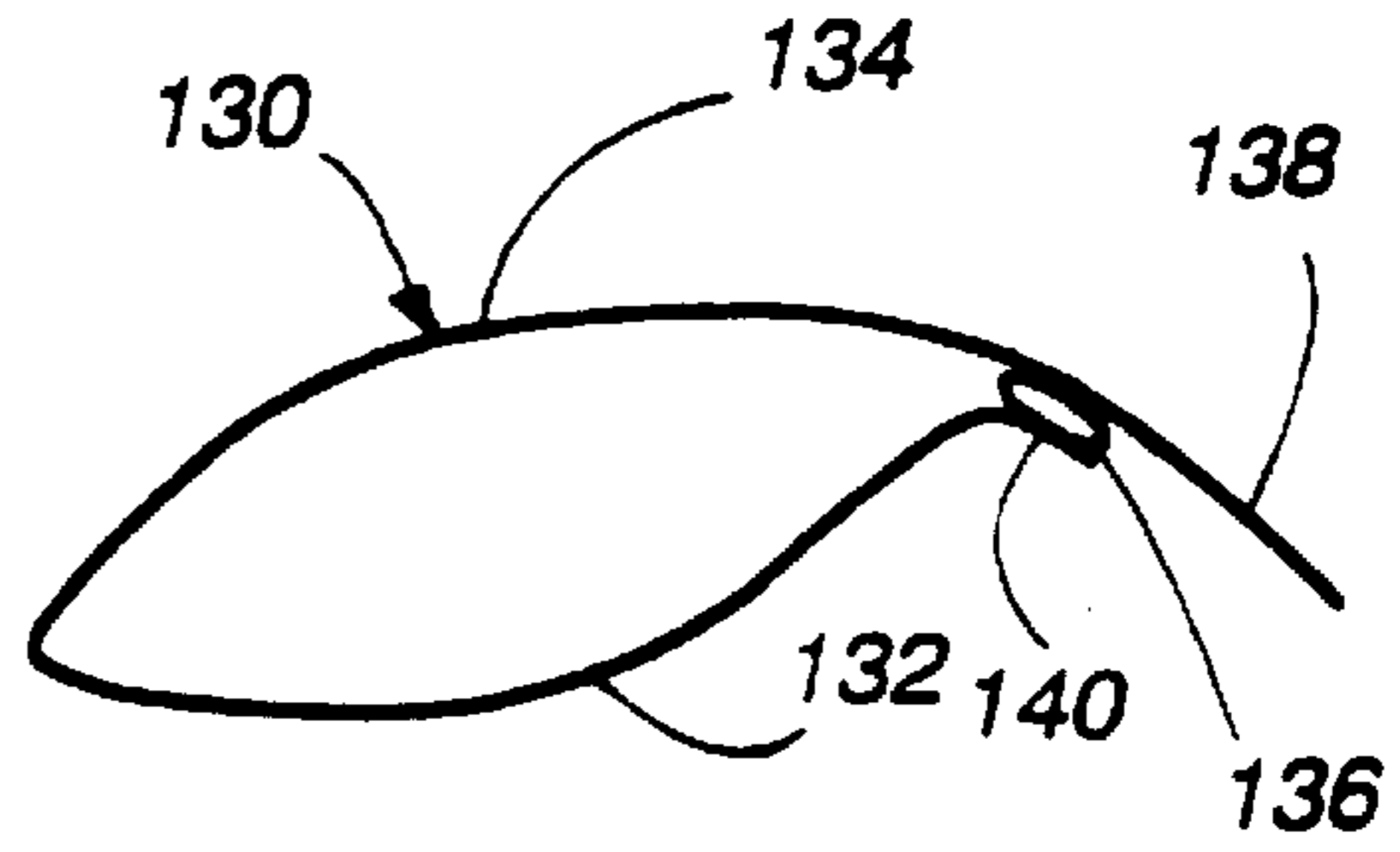


FIG. 15

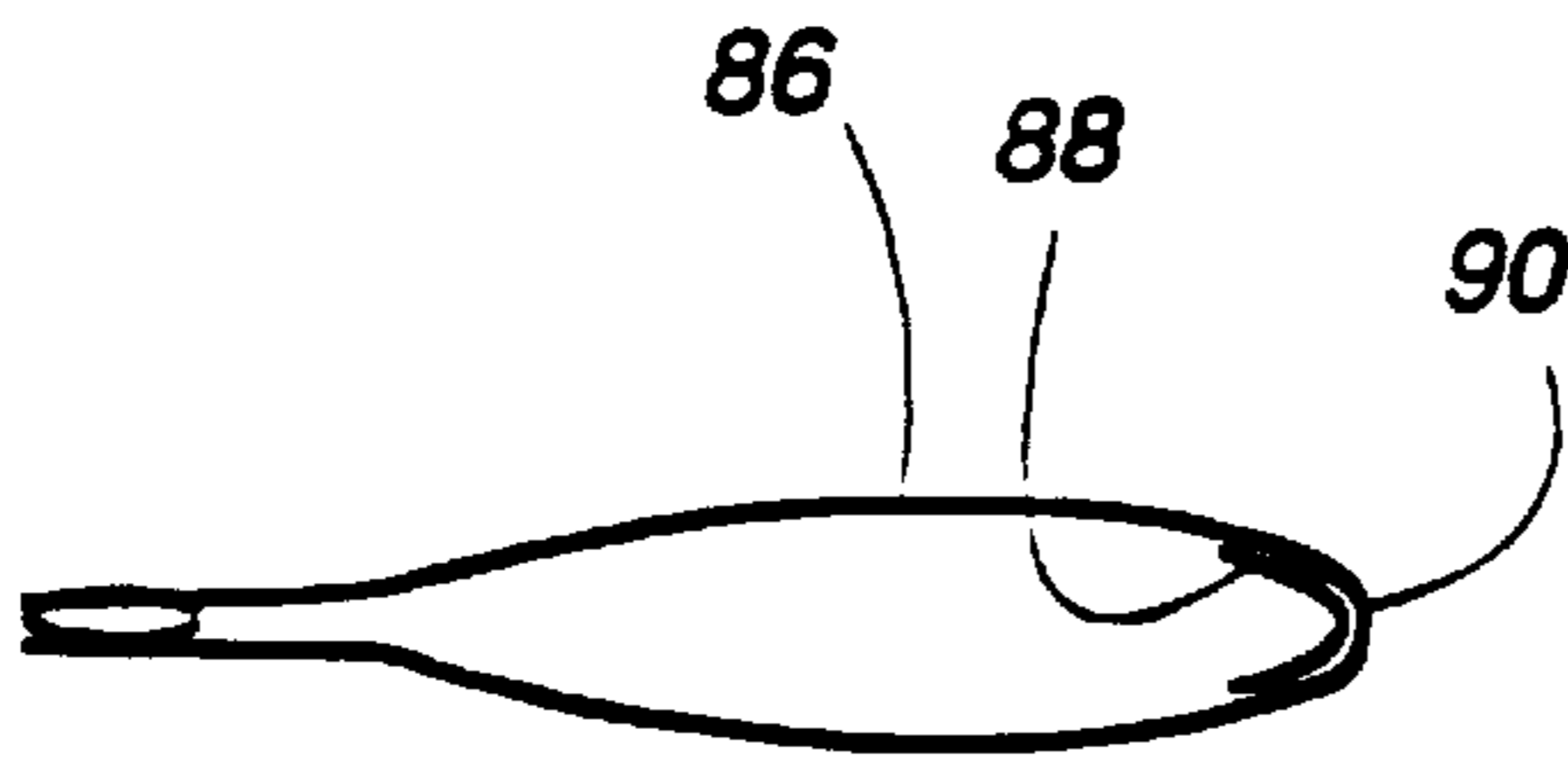


Fig. 12

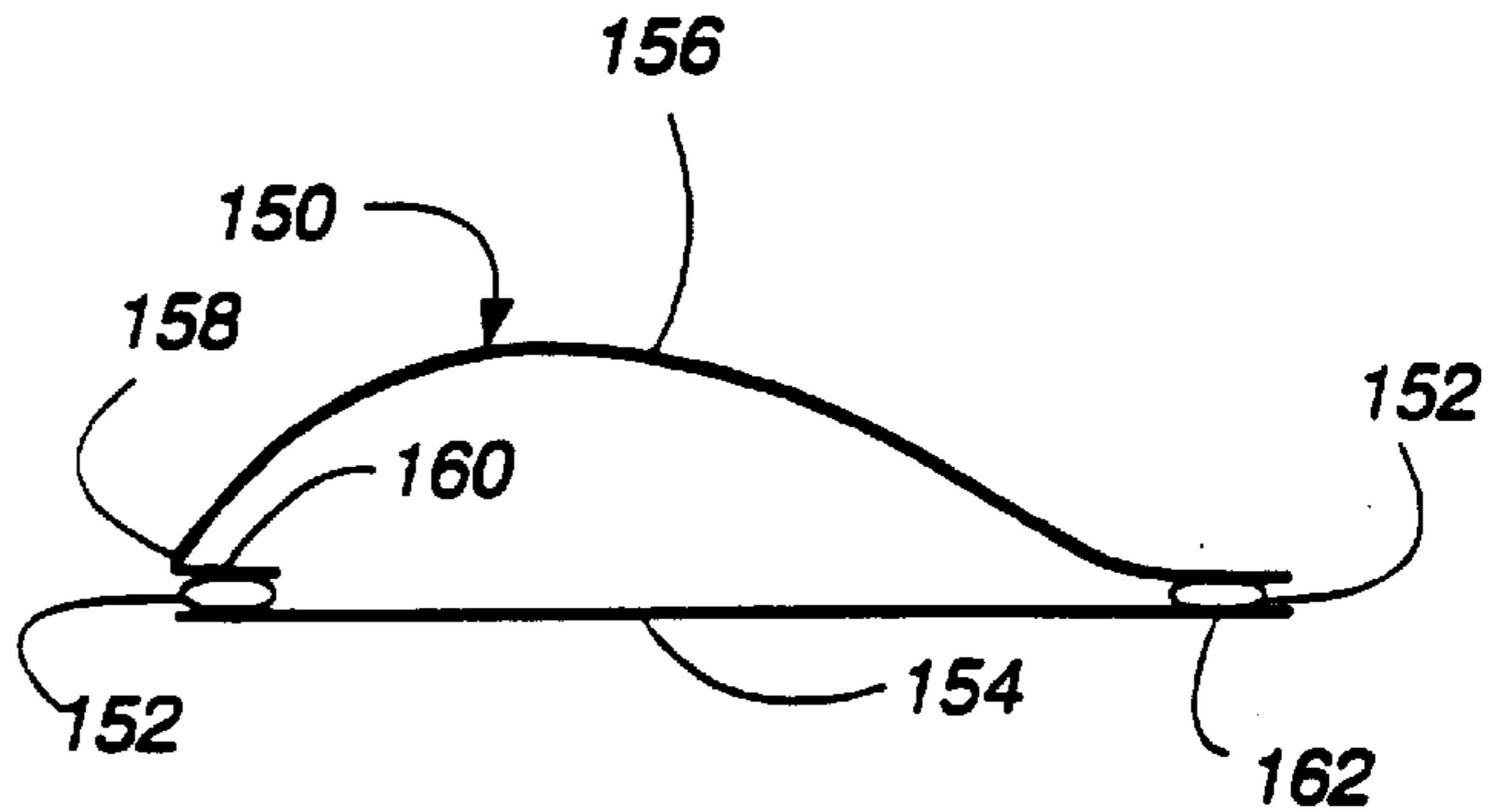


Fig. 16

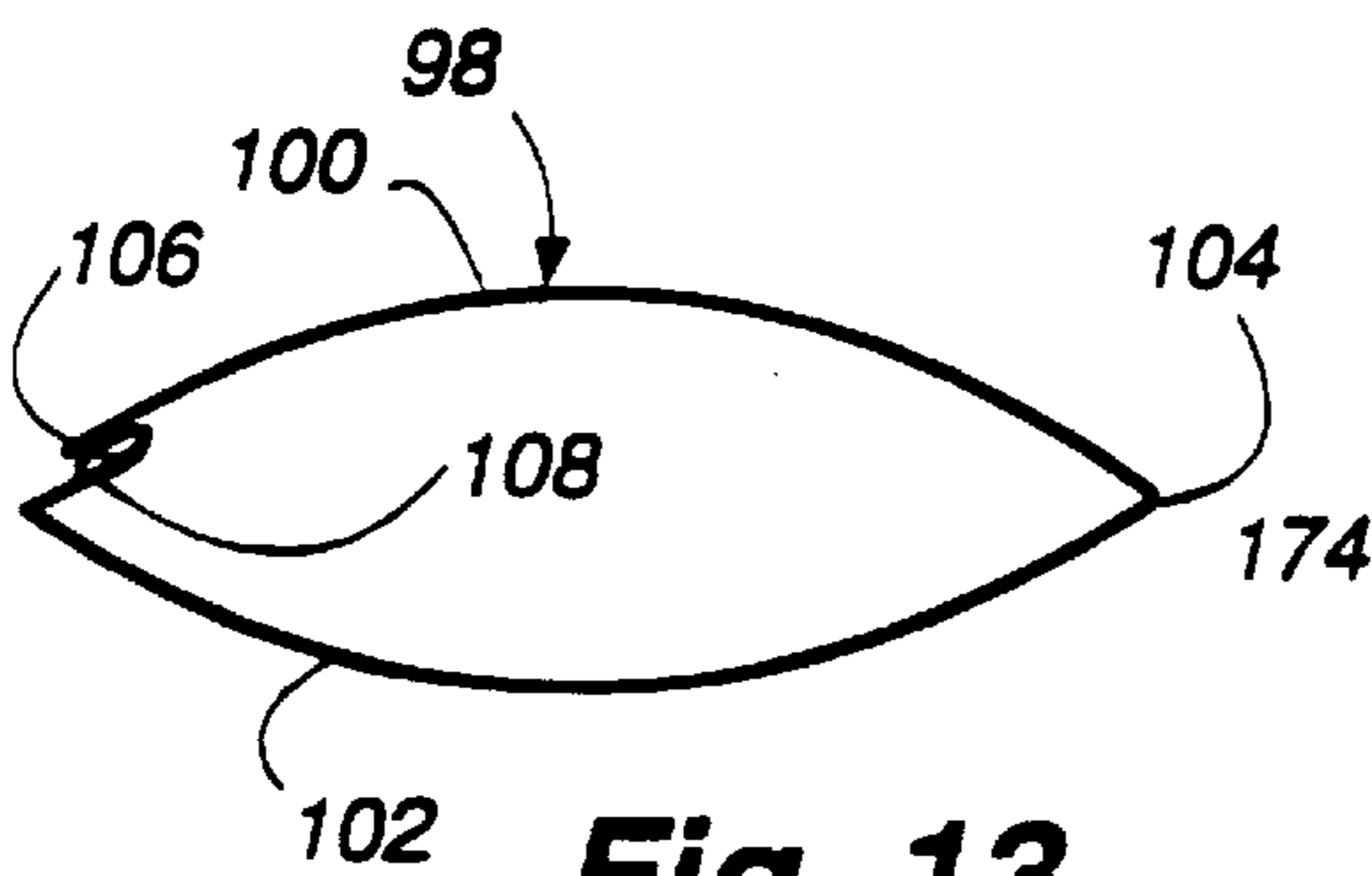


Fig. 13

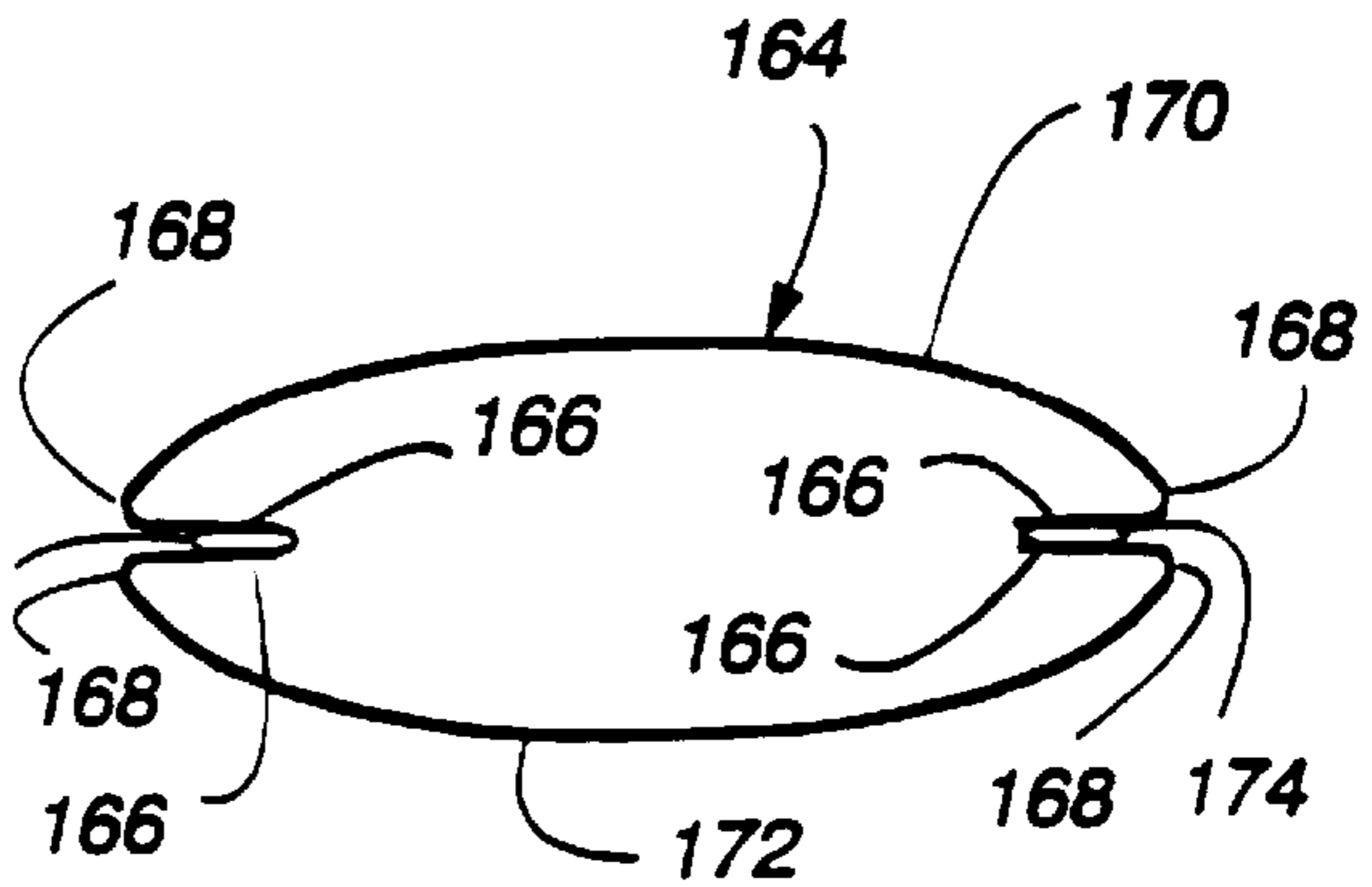


Fig. 17

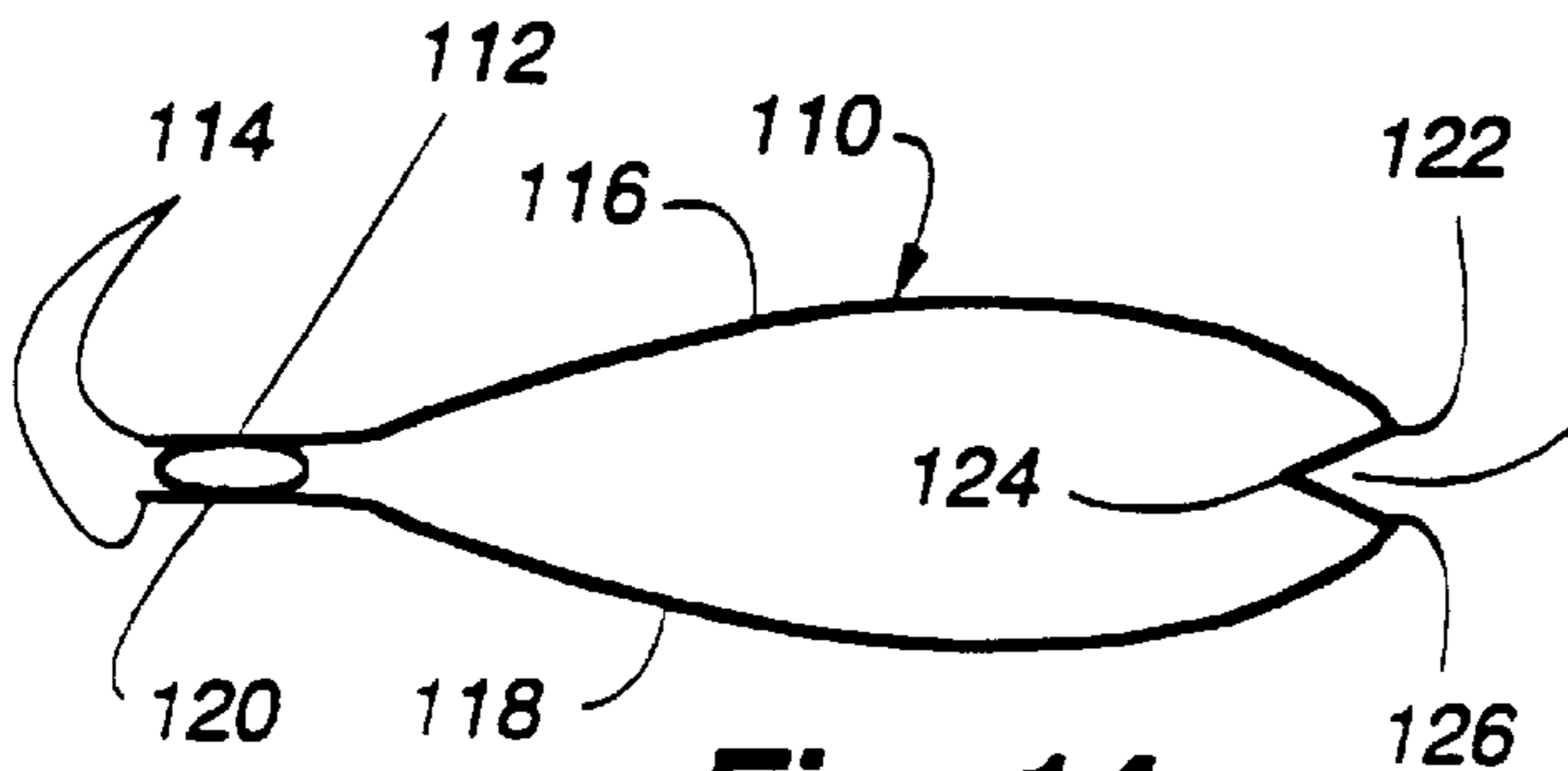


Fig. 14

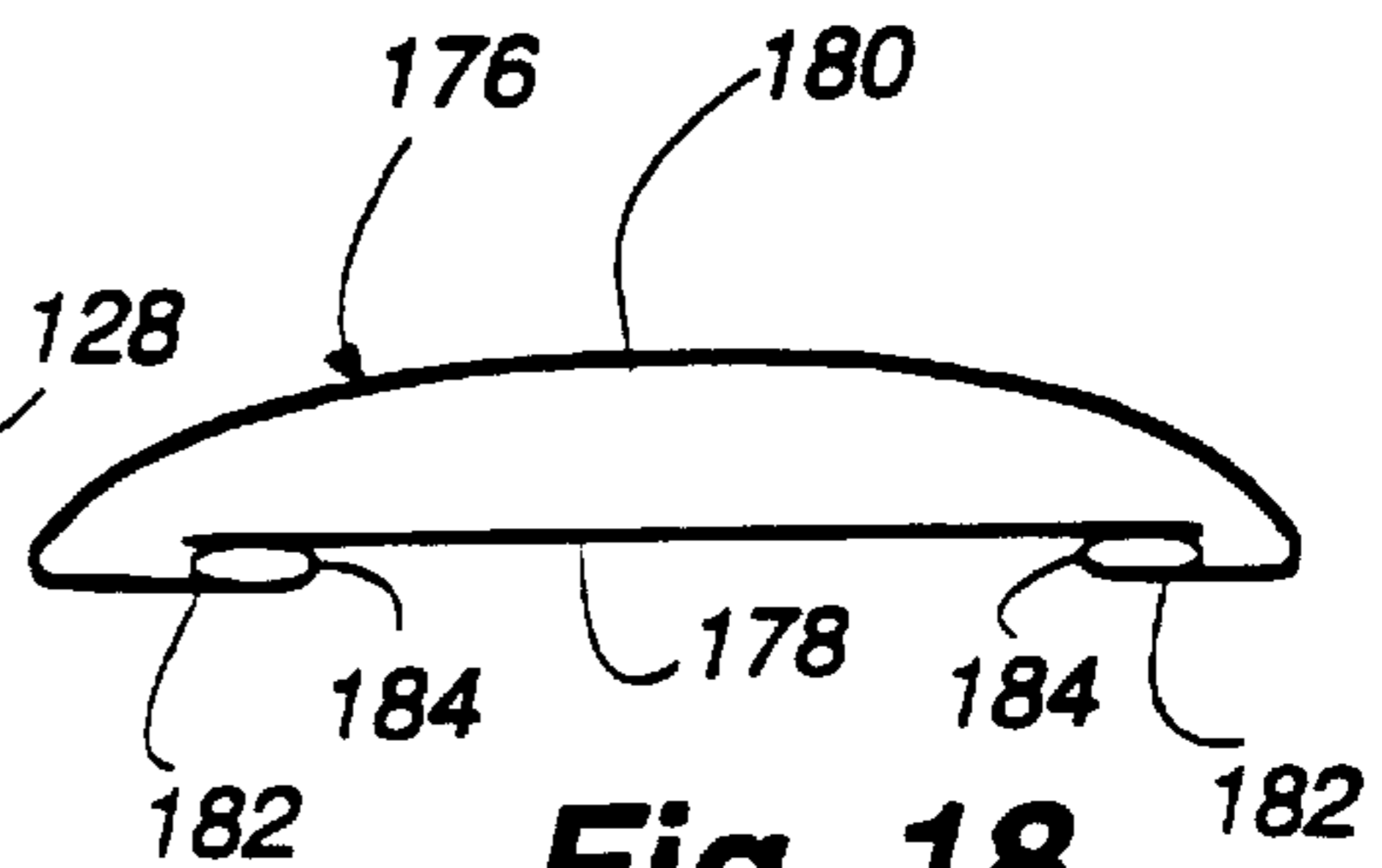


Fig. 18

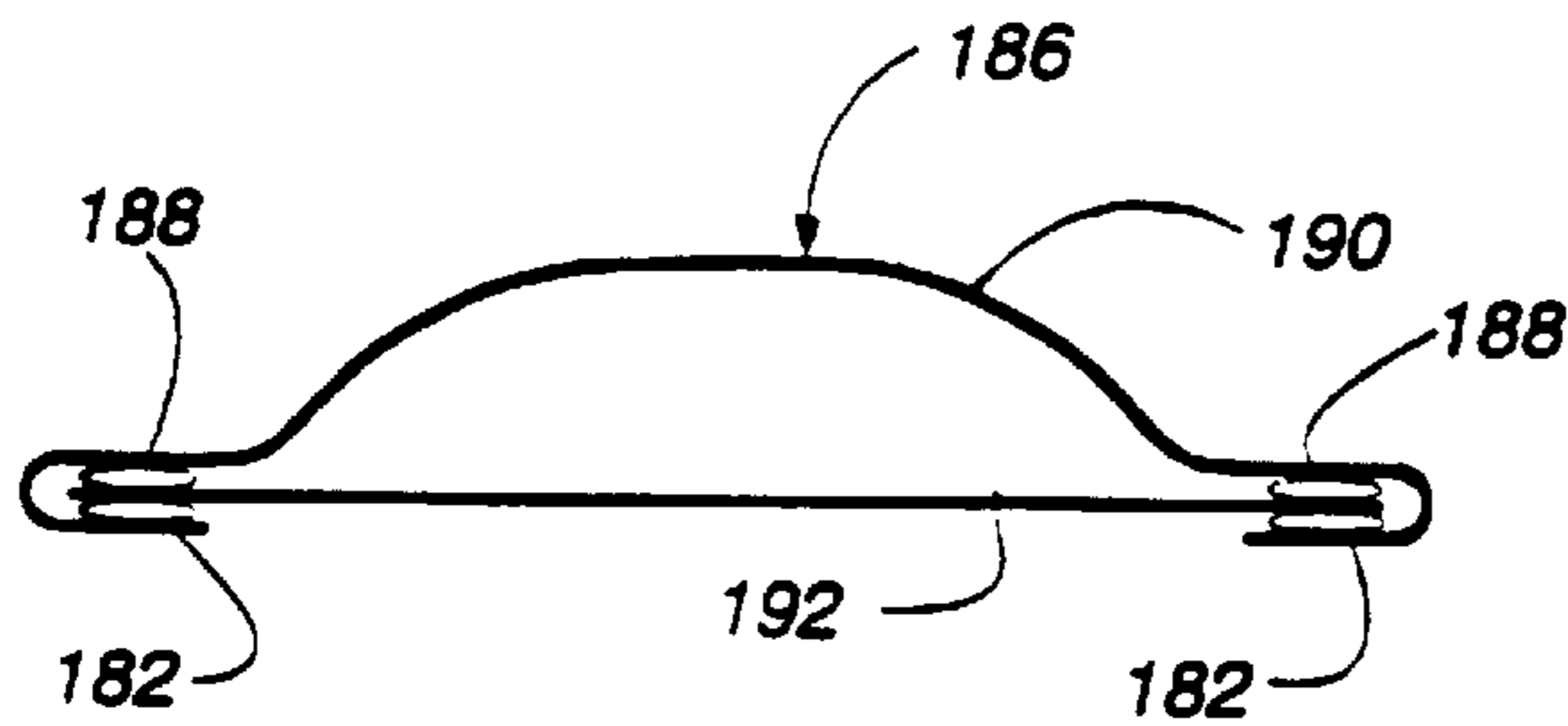


Fig. 19

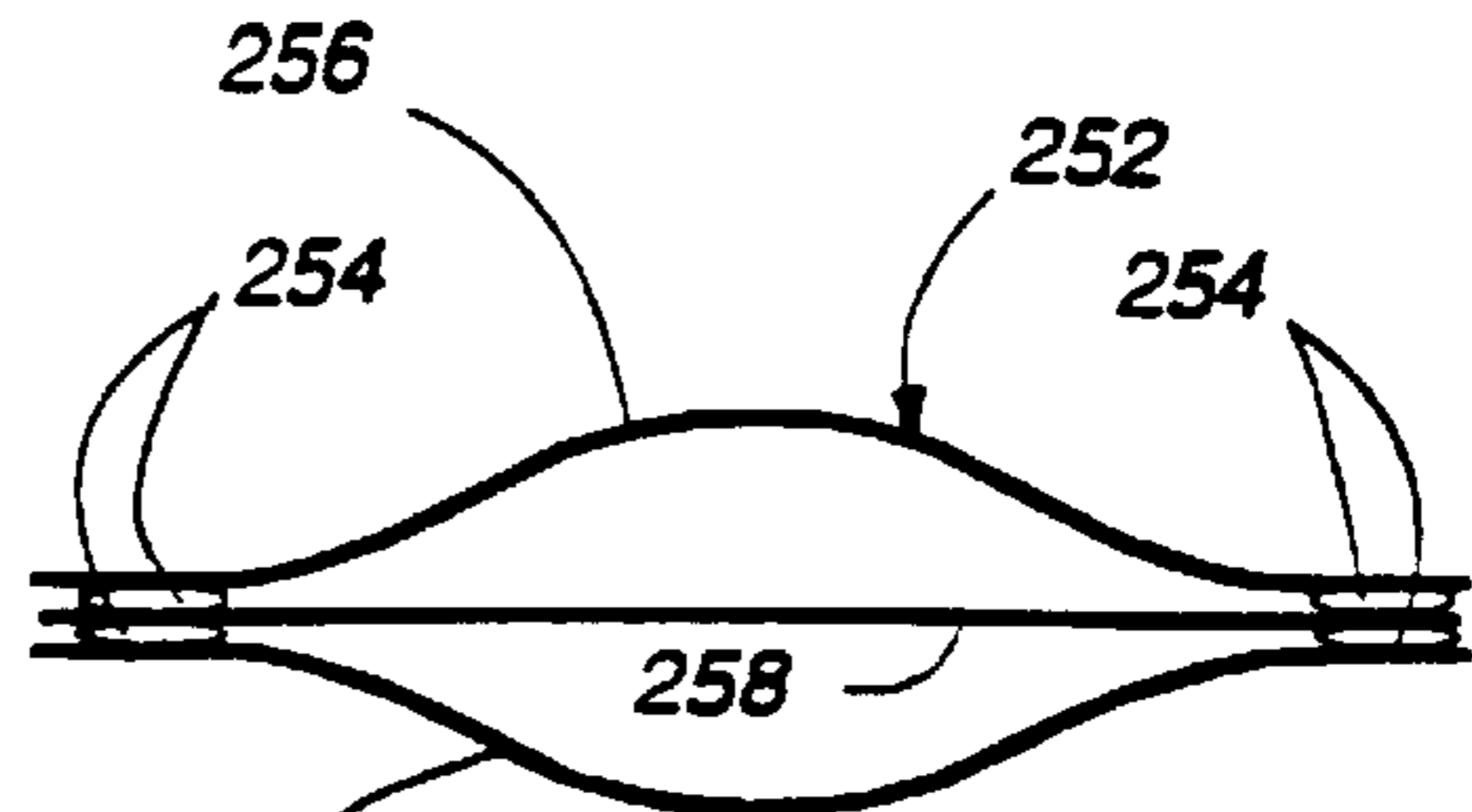


Fig. 23

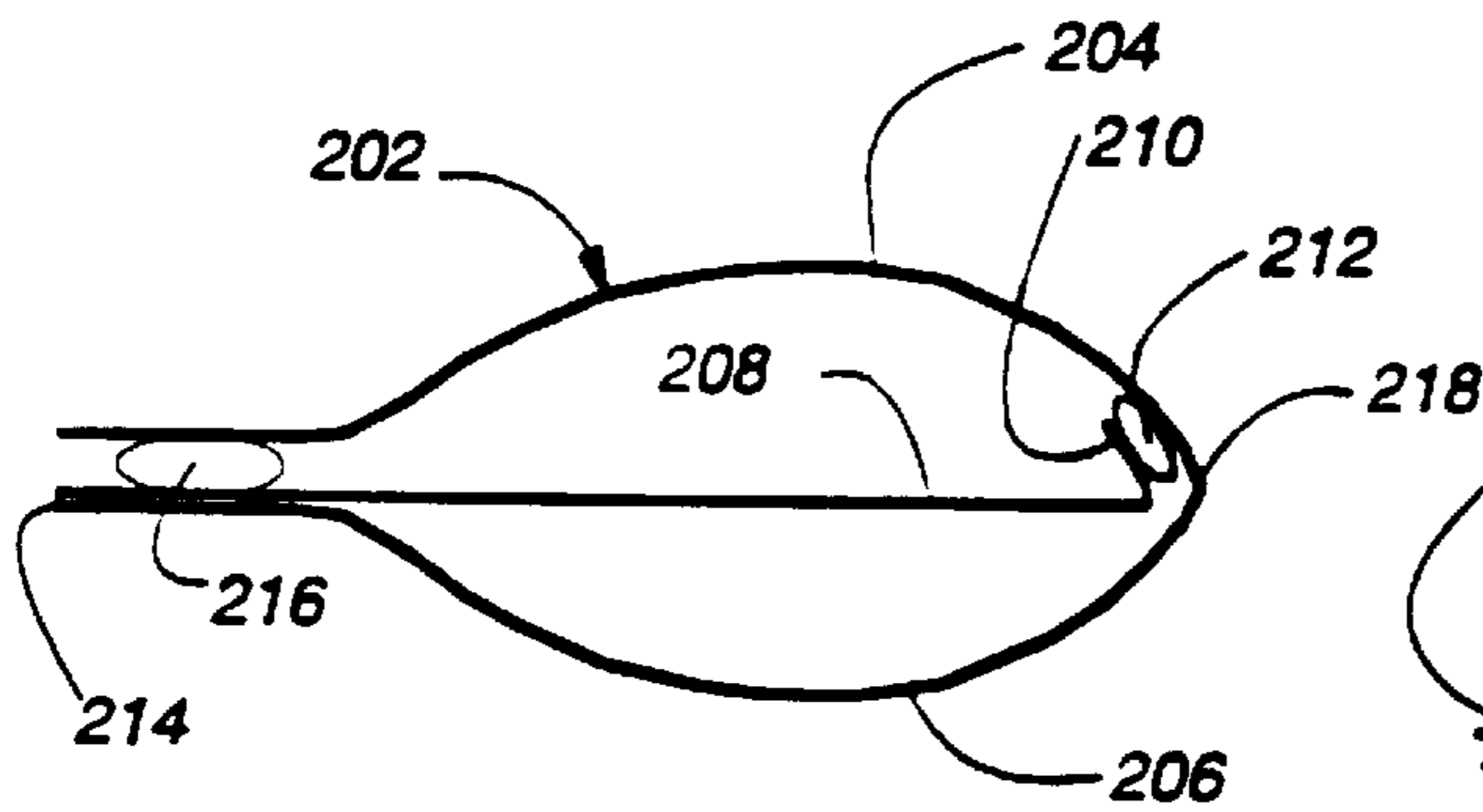


Fig. 20

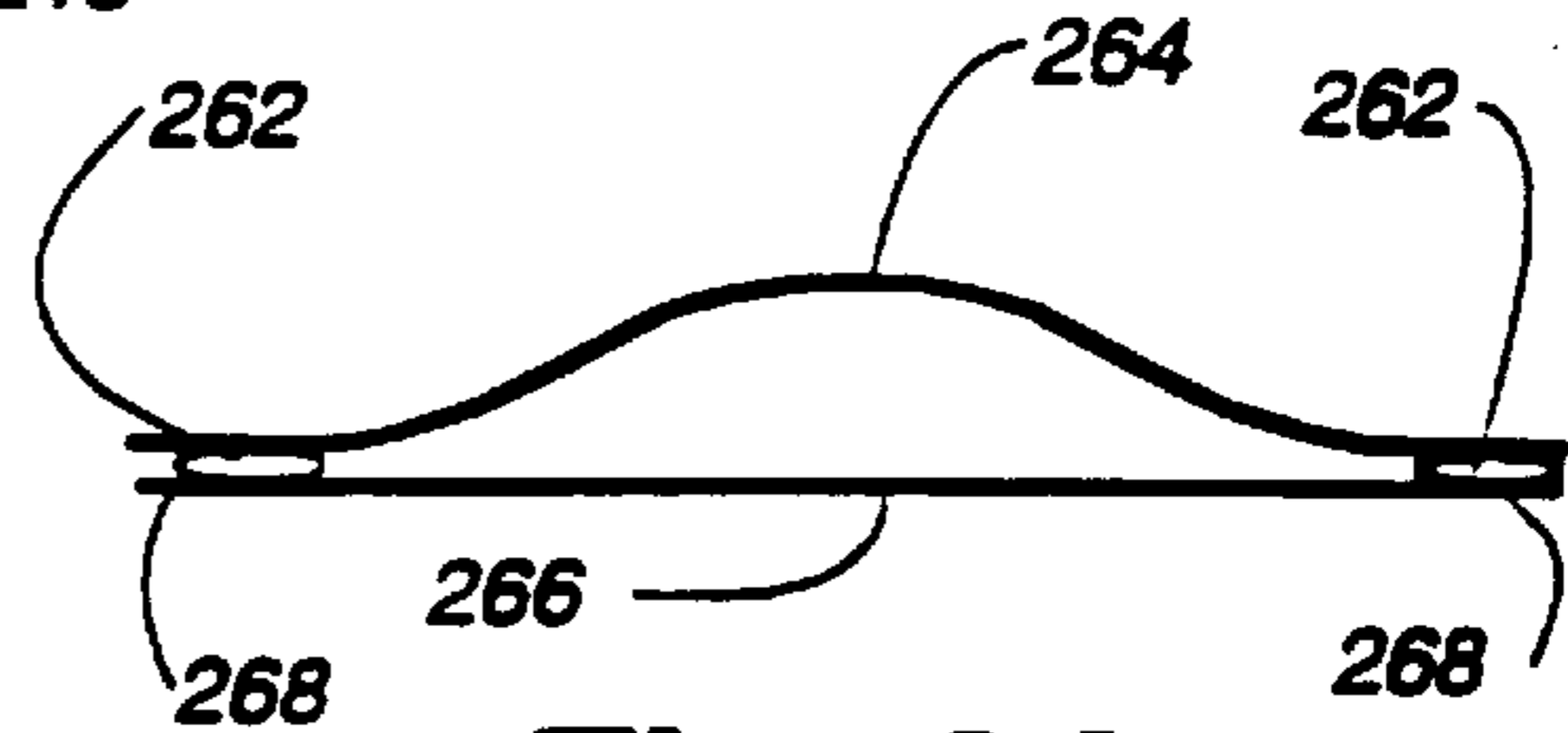


Fig. 24

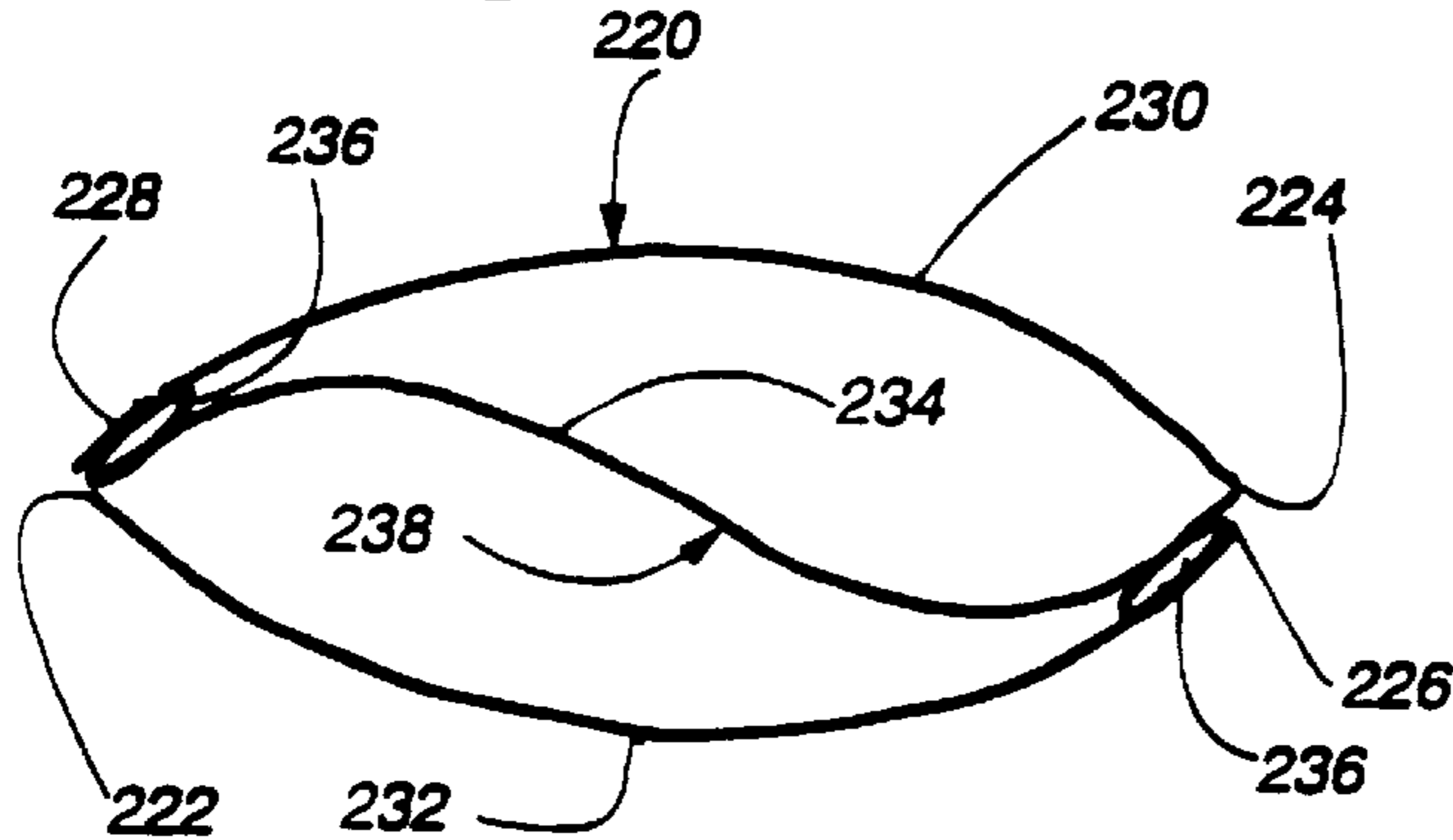


Fig. 21

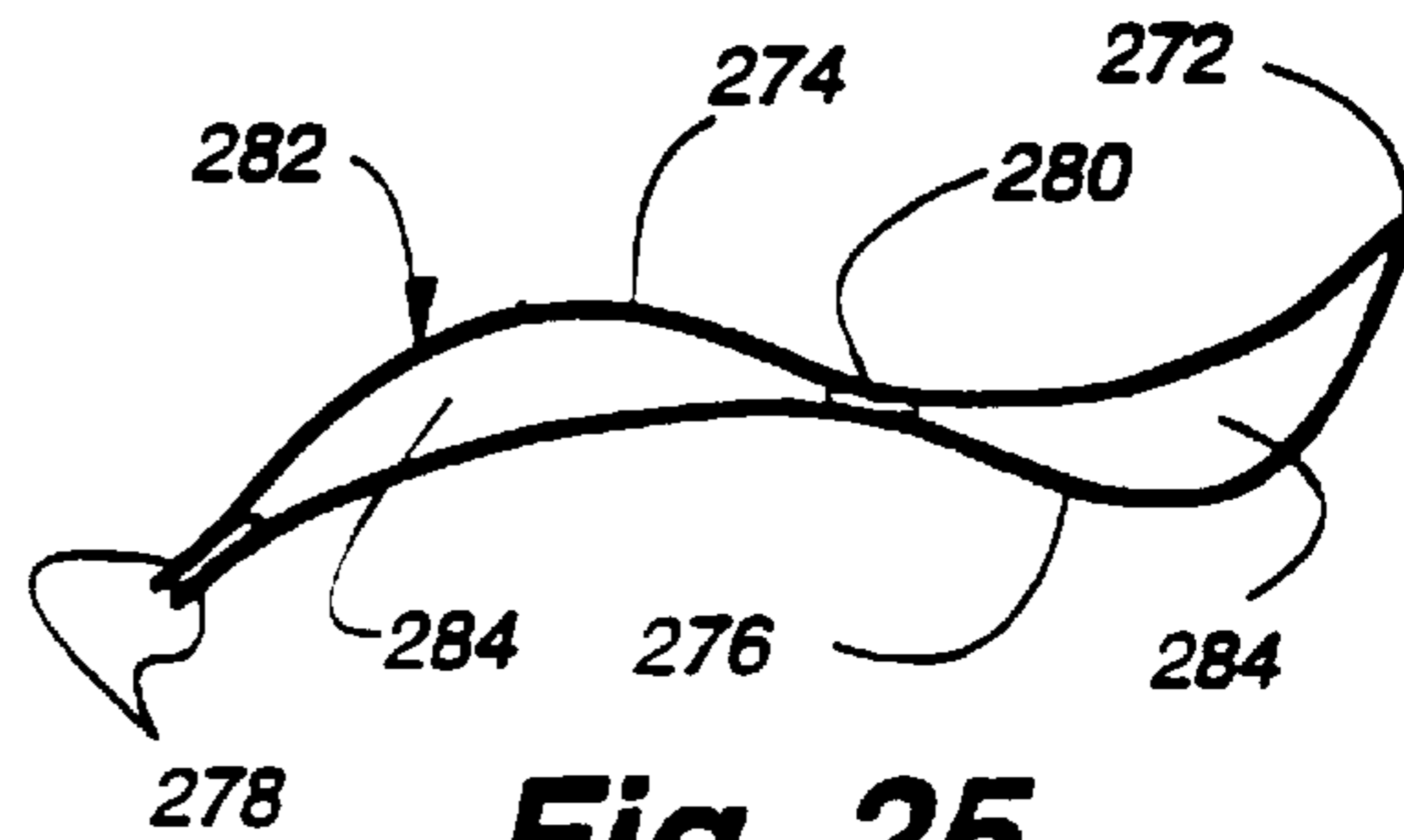


Fig. 25

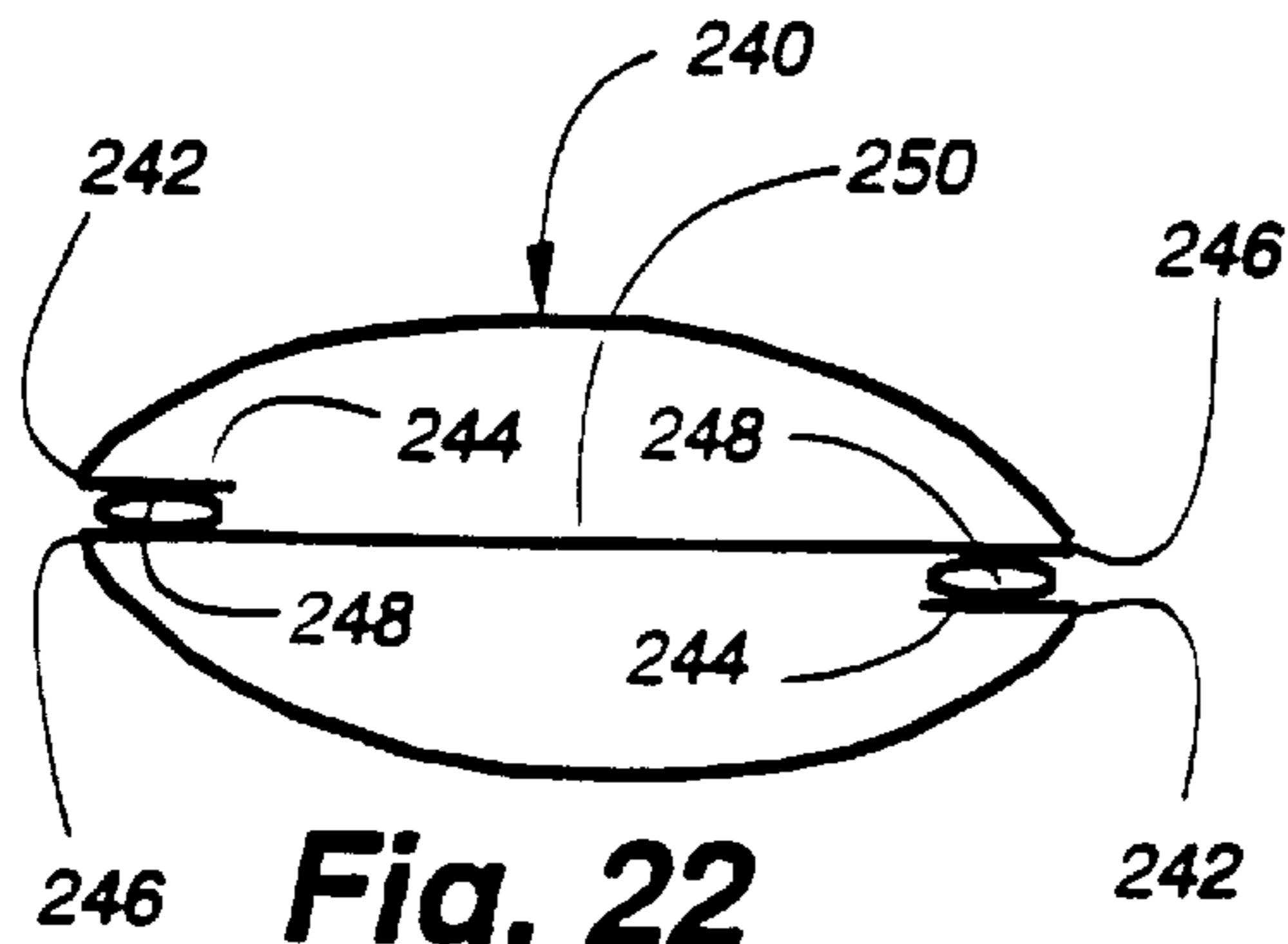


Fig. 22



SINGLE PLY FABRIC STRIP

ANGLE (DEGREES)	TORQUE INDEX FORCE (GRAMS)
0	0
30	1
60	2
90	3



DOUBLE PLY FABRIC STRIP

ANGLE (DEGREES)	TORQUE INDEX FORCE (GRAMS)
0	0
41	1
50	2
65	3
75	4
81	5
90	6



TUBULAR VANE OF PRESENT INVENTION

ANGLE (DEGREES)	TORQUE INDEX FORCE (GRAMS)
0	0
5	10
10	24
15	42
20	52
25	54
30	56
35	54
40	56
45	59
50	60
55	57
60	60
65	53



Fig. 26

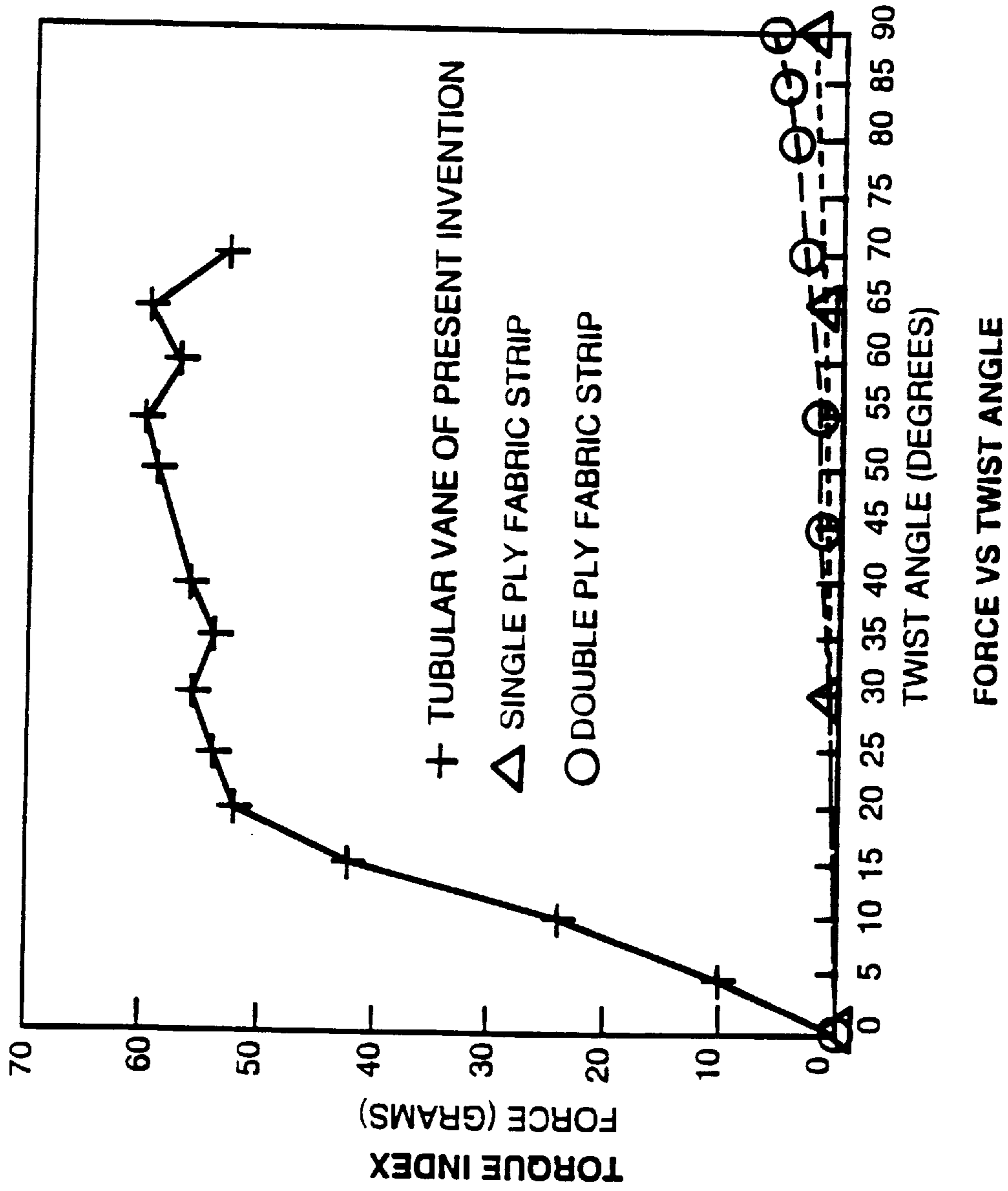


Fig. 27

FABRIC: (WITHOUT DIAGONAL DIMENSIONAL STABILITY)	
WOVEN TUBULAR VANE	
ANGLE (DEGREES)	TORQUE INDEX FORCE (GRAMS)
0	0
38	1
49	2
92	3

FABRIC: (WITH DIAGONAL DIMENSIONAL STABILITY)	
KNIT TUBULAR VANE	
ANGLE (DEGREES)	TORQUE INDEX FORCE (GRAMS)
0	0
2	2
10	10
15	14
20	20
25	23
30	24
35	27
40	27
45	26
50	26
55	28
60	29
65	30
70	31
75	31
80	34
85	34
90	35
100	32
110	32

Fig. 28

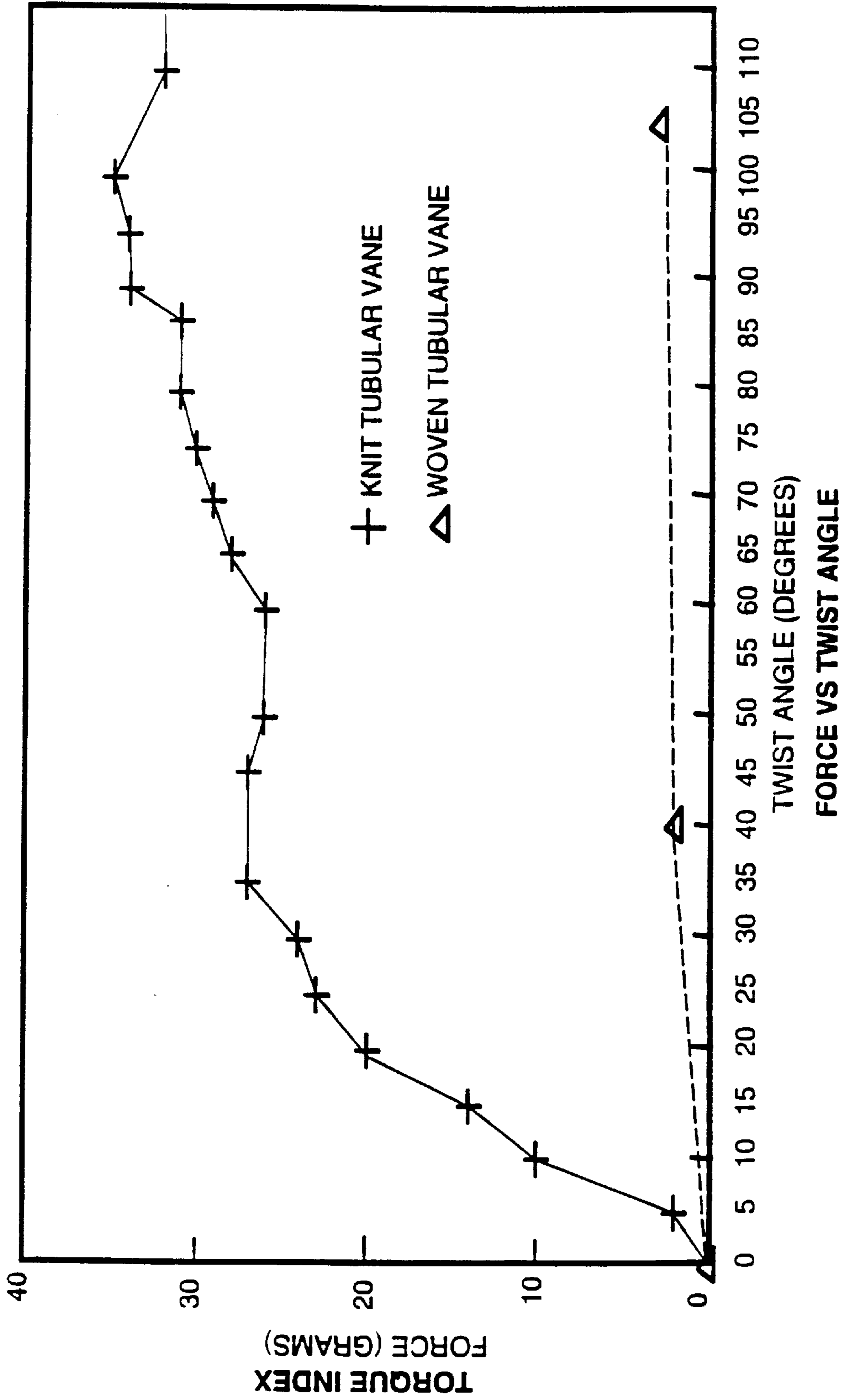


Fig. 29

VANE FOR AN ARCHITECTURAL COVERING

CROSS REFERENCE TO RELATED APPLICATIONS

This application is a continuation of U.S. application Ser. No. 08/853,307 filed May 8, 1997 which is a continuation of U.S. application Ser. No. 08/437,959 filed May 10, 1995 now abandoned.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to coverings for architectural openings and more particularly to an improved vane that may be used in a vertical window blind, door blind, or to otherwise furnish the interior of a dwelling.

2. Description of the Known Art

Vertical blinds have been known in the art for some time. A typical vertical blind has a headrail that contains a carrier mechanism, a tilt rod, and a plurality of operatively interconnected vertical vanes. The carrier mechanism includes a plurality of hangers for individually suspending the vertical vanes. The carrier mechanism is coupled to the tilt rod so that when the tilt rod is rotated the hangers are caused to rotate about vertical axes which in turn rotate the vertical vanes to which they are attached about the same axes. The vanes are always hung from their top edge with the hangers being undesirably visible or requiring a valence to cover them up.

Vanes for vertical window blinds are typically made with one or more of four different types of materials. These materials are fabric, polyvinylchloride (PVC), aluminum and wood. The most common vanes are made from either fabric, PVC or a combination of fabric and PVC. Fabric vanes offer a very appealing softer appearance. The fabric adds quality to a vane and gives it a finished look. It also provides a designer with a number of design choices regarding the type of fabric to use for a particular room. PVC vanes are plastic and therefore have a harder plastic appearance. One advantage of the PVC vane, however, is its strength. PVC vanes can be laminated or wrapped with fabric to provide the PVC strength with the fabric appearance.

There are disadvantages, however, to vanes made of fabric. PVC or combinations thereof Vanes made solely of fabric are thin, and tend to twist along their length when rotated from the top edge. They further are substantially two dimensional. PVC vanes also tend to twist along their length when rotated from the top edge. The PVC vanes are also normally thin, even though they can be molded to provide a three dimensional shape. This shape is usually curved in cross-section, e.g. a C-shape or an S-shape, and the thickness of the vane is usually about $\frac{1}{8}$ inch or less. Additional thickness is too costly for the window blind market.

Several hybrids exist for fabric vertical vanes. Fabric vanes are often treated with a stiffener to impart structural rigidity. The stiffener takes away the fabric's hand or softness, but retains the look of the fabric. The vane will still twist, but less than non-treated fabric vanes. The treated fabric vanes also tend to curl in direct sunlight if the stiffener is not applied uniformly. Another hybrid, as mentioned previously, is a PVC vane laminated with a fabric. Such a vane has the structural strength and three-dimensionality offered by a PVC vane with the appearance of a fabric vane. The fabric in this case also loses its hand or softness. Problems common with PVC/fabric laminate vanes are that

in sunlight, the fabric may curl and delaminate, there is increased assembly costs, the vanes are relatively heavy and when the fabric is only laminated onto one face of the PVC, the reverse side is aesthetically displeasing. Another design includes a PVC vane core that is wrapped loosely with fabric. This provides a softer product with a fabric look, but it is very costly and difficult to fabricate. One other approach is a PVC vane with a groove along each edge so that a fabric insert can be positioned in and along the faces of the PVC vane. This approach is also costly, does not prevent longitudinal twisting and the reverse face and the grooved edges detract from the fabric appearance.

All of the prior art vertical vanes cast a distinct well defined shadow on the adjacent vane when the vanes are completely closed and slightly overlapped in a window and are in direct sunlight. This shadow creates the effect of stripes on the surface of the closed vertical blind resulting in objectionable aesthetics.

Vanes, more commonly referred to as slats, found in venetian blinds, as opposed to vertical blinds typically have different qualities as they are disposed horizontally rather than vertically. In fact, some slats found in venetian blinds are of hollow construction. By way of example, U.S. Pat. No. 2,169,873 to W. D. Clark, Jr.; U.S. Pat. No. 2,326,454 to Scipio S. Gentile; and U.K. Patent No. 623,832 assigned to Chr. Fabers Fabriker disclose hollow slats for use in a venetian blind. Since slats in venetian blinds are disposed horizontally, they must be self-supporting along their length. A self-supporting slat by its very nature must be somewhat rigid and therefore will not have a soft hand or feel. The venetian blind slat is rotated about a horizontal longitudinal axis by conventional tape ladders on which it is supported. This method of support does not require energy transfer from one end of the slat to the other as with vertical blinds. A vane in a vertical blind is supported from its top edge and is preferably rotated from its top edge. Therefore, it is not necessary that it be self supporting along its length. To rotate a vertical blind vane, energy must be transmitted from the top of the vane to the bottom in order for the entire vane to rotate. Uniform rotation along the entire length of the vane has been a problem with prior art vertical vanes.

Therefore, it is an object of the present invention to provide a vane for a vertical blind that is three-dimensional, has a soft hand or feel, that does not twist from top to bottom when rotated from the top but rather rotates uniformly, that hides the hanger of the carrier mechanism, and that diffuses the light passing through the shade so that no distinct, sharply defined shadows are formed.

SUMMARY OF THE INVENTION

The vertical vane of the present invention is preferably tubular in configuration thereby providing three-dimensionality and torsional rigidity along its length. It is preferably formed from fabric having diagonal dimensional stability. Diagonal dimensional stability means that the vane fabric is not stretchy when pulled diagonally relative to the machine direction of the fabric. The machine direction of the fabric is defined as the dimension of the fabric extending in the direction the fabric is moved through the machine in which it is manufactured. The longitudinal dimension of the vane preferably extends in the machine direction of the fabric. The diagonal dimensionally stable fabric allows the vane to carry torque along the length of the tubular vane construction, thus inhibiting longitudinal twisting. Fabrics which are not totally stable but at least have diagonal dimensional memory may also be used such that if slightly

stretched along a diagonal will, over a short period of time return to the original orientation.

The tubular vane may be made from tubularly manufactured fabrics, a single sheet of fabric that is folded over onto itself to define a hollow vane or it may be made of multiple sheets of fabric joined together to define a hollow vane. The fabric may also be creased along a fold line to provide structural and/or aesthetic variety. A resilient layer may be laminated to the inner side of the sheet, i.e., the side that will be inside the vane. The resilient layer helps to spring the vane fabric back from a flattened state that may occur during shipping. It also helps to retain the vane's three-dimensionality.

In multiple sheet configurations, two sheets or more may be joined together with adhesive or by some other bonding method to create a tubular structure. In this type of configuration, many different shapes can be attained and resulting bond lines replace the crease or creases that may be found in a vane constructed with a single sheet of fabric. A prime feature in preventing twist in these arrangements and giving the vane torsional rigidity is diagonal dimensional stability or memory of the fabric. An advantage to this construction is that different materials may be used to construct the tubular vane for aesthetics and other purposes.

Another aspect of the invention is its ability to hide the hardware that is utilized to hang the vanes from a headrail. This makes for a far more pleasing aesthetic look. To achieve this, a hanger plate is inserted into the open top end of each vane and attached to the top of the vane. The hanger plate is preferably positioned so that the hanger that extends from a carrier mechanism mounted in the headrail is substantially hidden within the hollow interior of the tubular vane. Ideally, the hanger plate is positioned so that the top of the vane either abuts the bottom of the headrail or almost abuts the bottom of the headrail when the vane is hung on the hanger.

The vane may have a single hollow portion or cell, or may have multiple hollow portions or cells. These portions or cells being defined by the way the product is folded and constructed. The typical and most cost effective vane will have a single hollow section, even though multiple cell constructions also have benefits.

Another advantage of the invention is that the hollow vane diffuses light in a unique fashion. The shadow created by the overlap of two vanes is diffused by the tubular shape of the vane so the shadow is not apparent. This results in a product having a much more subdued and pleasing look over the harsh shadows of prior art vertical vanes. The thicker the tubular vane, the more apparent this effect becomes.

Other objects, features and advantages of the present invention will become more fully apparent from the following detailed description of the preferred embodiment, the appended claims and the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a frontal isometric view of a vertical window blind incorporating the tubular vane of the present invention.

FIG. 2 is a fragmentary isometric of the upper end of the tubular vane shown in FIG. 1 showing a hanger plate attached to the vane.

FIG. 3 is a fragmentary front elevation of a window blind incorporating the tubular vane of the present invention in the extended closed position illustrating how the hanger plates are hidden in the vanes.

FIG. 4 is a diagrammatic horizontal section taken through the tubular vane of FIG. 2 illustrating the diffusion of light passing through the vane.

FIG. 5 is a fragmentary horizontal section taken through several overlapped vanes of the type shown in FIG. 2 in the extended closed position of a window blind.

FIG. 6 is a schematic isometric illustrating a method of forming the vane shown in FIGS. 1 through 5.

FIG. 6A is a section taken along line 6A—6A of FIG. 6.

FIG. 6B is a section taken along line 6B—6B of FIG. 6.

FIG. 6C is a section taken along line 6C—6C of FIG. 6.

FIG. 6D is a section taken along line 6D—6D of FIG. 6.

FIG. 7 is a section taken through a first alternative embodiment of the vane.

FIG. 8 is an end view of a pre-creased web of material used to manufacture the tubular vane of FIG. 7.

FIG. 9 is a transverse section of a folded web during construction of the vane of FIG. 7 better illustrating the crease shown in FIG. 8.

FIG. 10 is an enlarged fragmentary section illustrating the relative size of the crease.

FIG. 11 is an end view of a second alternative embodiment of the vane.

FIG. 12 is an end view of a third alternative embodiment of the vane.

FIG. 13 is an end view of a fourth alternative embodiment of the vane.

FIG. 14 is an end view of a fifth alternative embodiment of the vane.

FIG. 15 is an end view of a sixth alternative embodiment of the vane.

FIG. 16 is an end view of a seventh alternative embodiment of the vane.

FIG. 17 is an end view of an eighth alternative embodiment of the vane.

FIG. 18 is an end view of a ninth alternative embodiment of the vane.

FIG. 19 is an end view of a tenth alternative embodiment of the vane.

FIG. 20 is an end view of an eleventh alternative embodiment of the vane.

FIG. 21 is an end view of a twelfth alternative embodiment of the vane.

FIG. 22 is an end view of a thirteenth alternative embodiment of the vane.

FIG. 23 is an end view of a fourteenth alternative embodiment of the vane.

FIG. 24 is an end view of a fifteenth alternative embodiment of the vane.

FIG. 25 is an end view of a sixteenth alternative embodiment of the vane.

FIG. 26 is a table comparing the torque index of vanes manufactured in accordance with the present invention with single ply and double ply planar vanes.

FIG. 27 is a graph corresponding to the tabular information of FIG. 26.

FIG. 28 is a table comparing tubular vanes made of fabrics with and without diagonal, dimensional stability.

FIG. 29 is a graph corresponding to the tabular information of FIG. 28.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring first to FIG. 1, a covering 30 in the form of an architectural covering device incorporating the vanes 32 of

the present invention is illustrated. For purposes of the present disclosure, the covering **30** will normally be referred to as a vertical window blind, it being recognized that the covering could be used for other architectural purposes such as on doors or to otherwise furnish the interior of dwellings. The window blind broadly includes a headrail **34** suspendable from a wall or ceiling adjacent to a window opening and an operating system (not fully shown) connected to the headrail and adapted to suspend a plurality of the vertically extending vanes **32**.

The operating system, which is not fully shown as it does not form part of the present invention, would preferably include a plurality of carriers associated with each vane **32** with the carriers being operatively engaged with a horizontally disposed tilt rod in the headrail such that rotation of the tilt rod causes the carriers to pivot about a vertical axis. Such operating systems for vertical vane window coverings are well known in the art. A hanger plate **36** (FIG. 2) affixed internally to the upper end of a tubular vane is adapted to be releasably connected to an associate carrier. The hanger plate can be affixed to either side of the vane. The hanger plate is preferably ultrasonically bonded to the vane but may be affixed in any other suitable manner so as to move in unison with the associated vane.

The window blind **30** is operative for movement between extended and retracted positions, as well as open and closed positions. In the extended position shown in FIG. 1, the vanes are uniformly distributed across the window opening, while in the retracted position (not shown), the vanes are horizontally stacked together adjacent either or both sides of the window opening. The vanes are pivotal to move the blind between the open and closed positions. In the open position shown in FIG. 1, the vanes extend perpendicularly to the headrail, while in the closed position of FIGS. 3 and 5, they preferably partially overlap in shingle-like touching relation and extend in substantially parallel relation to the headrail.

Referencing FIG. 2, a vane **32** fabricated in accordance with the present invention can be seen to be made of a single strip or web of sheet material, preferably fabric, formed into an elongated tube so as to give the vane torsional rigidity along its length. The vane therefore has an inner surface **38** and an outer surface **40**. The material may be a single layer or a laminate. If it is a laminate, the inner surface of the laminate would normally be functional and possibly not as aesthetically pleasing while the outer surface of the laminate would normally be less functional and more aesthetically pleasing. The tubular construction of the vane is both structurally sound and aesthetically pleasing.

The vane **32** has two equal length outwardly convex outer walls **42** and **44** defining a smooth rounded curve along one folded side or front vane section **46** of the vane and a relatively thin substantially flat tail **48** at the other side or rear vane section **50** of the vane where the free edges **52** of the strip of material from which the vane is made are disposed proximate each other. The free edges **52** of the strip are joined together, as with adhesive, along a bond line **54** extending the length of the vane. The folded one side **46** of the vane is rounded so as to simulate a rounded pleat found in conventional draperies. The spacing between the walls **42** and **44** of the vane at the location where they are maximally spaced, as designated by the letter "X" in FIG. 2, is preferably in the range of $\frac{1}{8}$ " to 1" for a vane that is three and one-half inches wide from the rounded side **46** to the tail side **50**. This particular structure of the vane makes it possible to use a number of materials, many of which do not have inherent structural rigidity, but which are inherently somewhat biased toward a flat orientation to create a hollow

tubular vane suitable for use in a vertical vane window covering. The availability of various materials creates a wide variety of choices of textures, colors and fabrics.

The aesthetic attributes of the design of the vane **32** stem from its three-dimensionality, the hollowness of the vane, the tail **48**, and the fact that different materials may be used in the construction. The three-dimensionality of the vane provides a softer, less harsh appearance in the window than conventional fabric vertical vanes. The soft appearance is present in both the open and the closed positions of the vanes. Further, in the retracted position the blind provides a curtain like look.

The hollow vanes **32** provide two significant functional advantages over prior art vertical vanes. The first is that the hanger plate **36** can be totally hidden within the vane as best seen in FIGS. 2 and 3. In prior art vertical blinds the hardware is visible and is not very attractive. The second advantage of the hollow vane is that it diffuses light in a fashion that breaks up the harsh shadows created with prior art vertical vanes. This diffusion is a result of two effects as illustrated in FIG. 4. The first effect results in diffusion when direct sunlight is diffused by the first wall **42** of the vane so a distinct shadow is not cast on the second wall **44** of the vane. The light diffusion is inherent to a fabric and is enhanced by the second wall of the tubular vane. The second effect is the internal reflection of sunlight within the hollow interior of the tubular vane. If the inner surface **38** is white, it reflects light. The reflected light is spread over the entire surface of the vane and thus, instead of a distinct shadow at the point of overlap of two adjacent vanes, a diffuse or subtle shadow occurs.

The relatively flat and thin tail **48** of the vane **32** is adapted to overlap (FIG. 5) an adjacent vane when the window covering is in the extended closed position and, therefore, improves vane closure of the blind. Enhanced vane closure improves the overall performance of the blind for providing privacy and light control. It also results in a more attractive product because no unwanted light can shine through gaps in the blind. It will be appreciated that whether or not the blind is in the open or closed position, a rounded surface of the vane faces the interior of the building structure in which the blind is mounted thereby presenting a soft appearance similar to conventional drapery.

The vane **32** is made of a flexible material and functions best if the material has diagonal, dimensional stability. Diagonal, dimensional stability is a characteristic of a fabric that substantially prevents the fabric from stretching or shrinking along a line diagonal to either the machine direction of the fabric or the cross-direction of the fabric. For purposes of the present disclosure, a fabric that is diagonally dimensionally stable is defined as a fabric that can be stretched no more than 10% along a forty-five degree diagonal to the machine direction of the fabric when a force of eight ounces is applied between two points along this diagonal. As mentioned previously, it is preferable that the longitudinal dimension of the vane extends in the machine direction of the fabric. The diagonal, dimensional stability is a factor in the vanes' ability to resist twisting from top to bottom when rotated from the top. The diagonally, dimensionally stable characteristic of the material facilitates the transfer of torque along the length of the tubular vane. The diagonal, dimensional stability of the fabric, in conjunction with the hollow structure of the vane, essentially prevents longitudinal twisting even though the vane will readily bend under gravity if disposed horizontally.

Examples of materials having diagonal, dimensional stability are almost all nonwoven fabrics, and some knit

fabrics. Wovens are generally quite stretchy when pulled diagonally, though it is not beyond comprehension that a diagonally, dimensionally stable woven could be created such as by laminating the woven to a stabilizing nonwoven of some kind, a film, or by using large amounts of stiffener.

It is preferred, though not essential, that the material give a nice quality of transmitted light. The preferred material is white so as to provide a transmitted light that is of a nice white color and quality. Major variations do exist in the quality of vane materials and it is difficult to judge the quality of the light other than to test variations with a consumer panel.

The strength requirement for material is that it be strong enough to not be torn easily and that it does not pill when abraded. The requirement that the material does not tear is especially relevant at the location in the vane where the hanger plate **36** is attached.

The material desirably also has a very nice hand. The hand of a fabric is its tactile qualities that include softness, firmness, elasticity, fineness, drape and other qualities perceived by touch. A fabric with a nice hand can be used for the vane as long as it has or can be provided with diagonal, dimensional stability since the fabric does not have to be treated with a stiffener to transfer torque when in a tubular configuration.

A material that has performed satisfactorily for constructing the vane is a 100 gram/m² acrylic bonded polyester spunbond nonwoven fabric manufactured by Unitika Corporation headquartered in Japan. Another suitable material is an opaque knit fabric identified by style number 34184 and manufactured by Guilford Mills of North Carolina. Both of these fabrics give a good balance of the characteristics described above. In addition, knitted or woven fabrics could be laminated to a nonwoven or knit fabric of the type mentioned.

While it is preferred that the fabric be diagonally, dimensionally stable, fabrics which have diagonal, dimensional memory may also be used. A fabric with such memory might be slightly more stretchable along its diagonal, then a fabric that is diagonally, dimensionally stable but will return to its original orientation over a relatively short period of time. For purposes of the present disclosure, a tubular vane made in accordance with the present invention and from a fabric that has diagonal. Dimension memory will return to its original orientation in less than two minutes when twisted along its longitudinal axis 45 degrees from top to bottom and the vane is 84 inches in length and 3.5 inches in width. In other words the fabric would have some degree of resiliency along its diagonals.

As mentioned previously, the vane **32** is made from an elongated web or strip of material. The strip is rectangular in configuration so as to have the aforementioned two longitudinally extending side edges. The strip is formed into a tube generally simulating an airfoil. This tubular construction provides the vane **32** with torsional rigidity along its length which is enhanced by the use of a diagonally, dimensionally stable fabric. The torsional rigidity resists the twisting that prior art vertical vanes have exhibited.

The preferred method of producing the vane **32** requires several steps schematically illustrated in FIGS. **6**, **6A**, **6B**, **6C** and **6D**. The first step is heat stabilization of the material used to manufacture the vane if the material is a fabric. Non-fabrics, such as paper or the like, would not have to be heat stabilized since such materials would not be subject to shrinkage. Heat stabilization is done to prevent differential shrinkage of the vane which will cause the vane to bow. The

heat stabilization is performed while a web or strip of the fabric **55** is run through a fabric straightener **57**. A seven-inch wide web has been found suitable but other widths of material could be used. The fabric straightener may consist of a heat roller **59** and a cooling roller **61**. The fabric straightener takes any inherent bow, or curve, out of the raw fabric before it is further processed. The fabric straightener **57** is desirable because the tubular vane construction can amplify any curve present in the raw fabric into a significant bow in the finished vane. For example, if a roll of 7-inch wide vane material is rolled and laid flat on the floor over a length of 50 feet, the material may bow as much as ¼ inch over the 50-foot length. When this bowed material is produced into a vane, the vane might also have ¼ inch or more of bow in a six foot length. This amount of bow is typically unacceptable in the window covering industry where aesthetics are of prime importance. In fact, any bow greater than about ⅛ inch in a vane that is 84 inches long or less is generally unacceptable.

The straightened fabric **55** is then folded by a folder or former **63** as illustrated in FIGS. **6**, **6A**, **6B**, **6C** and **6D** by simultaneously raising the side edges **65** of the web until they are disposed proximate each other as the web is advanced through the folder or former. The sides should be raised simultaneously rather than folding one side onto the other side because the stresses caused by folding will be uniform on both sides of the web. The folding is accomplished by running the web through the folder or former that has an internal contoured wall that captures the web and gently causes both sides of the web to move toward one another. The sides edges **65** eventually lie proximate to each other. The folding apparatus preferably has a central member or beam **67** that holds the creased web down as it is folding the sides of the web.

FIGS. **6A–6D** illustrate in cross-section the configuration of the internal wail **75** of the folder or former **63** and its affect on the web of fabric **55** as the fabric is moved through the folder. It should be appreciated that the fabric inherently wants to remain flat or in other words is somewhat biased toward a flat orientation so that it will naturally follow the contours of the internal wall of the former. As can be seen in FIG. **6A**, the folder at a location upstream from its longitudinal center defines a relatively wide trough wherein the side edges **65** of the web are lifted slightly. In FIG. **6B**, which is a cross-section downstream from FIG. **6A**, the trough is slightly narrower and the side edges **65** have been raised considerably. The lowermost portion of the web, at the longitudinal center of the web, has been folded into the rounded side **46**.

FIG. **6C** is a cross-section near the downstream end of the folder and it will be seen that the trough is shaped generally like a narrow U and is even narrower than it is at the extreme downstream end shown in FIG. **6D**. Further, the lower end of the trough has a relatively narrow V-shaped section **77** that forms a very slight crease in the rounded and folded side **46**. The crease is not enough to form a permanent bend in the fibers of the fabric but only enough to deform the fabric so that the fold is slightly narrower than it would be without the slight crease and is springy or resilient so as to retain the bias that urges the side walls **42** and **44** away from each other. The bias on the side walls forces the tubular fabric web to expand and follow the contour of the inner wall **75** of the folder as it widens at the downstream end of the folder as shown in FIG. **6D**.

When the fabric is completely folded, two continuous belts **69** (FIG. **6**) traveling at the same speed adjacent to one another can be used to nip the fabric and pull the fabric

through a glue applicator **71**. The glue applicator would insert glue along the bond line **54** (FIG. **2**) between the two walls **42** and **44** along the side edges **65**. Side pressure from the two belts **69** can then be used to close the walls onto the line of glue to create a permanent bond. The preferred glue for this application is a Griltex 6G manufactured by EMS Inc. of Sumter, S.C. Misalignments in forming the vane as described may cause twisted or bowed vanes, so maintaining proper alignment of the web of fabric as it is folded and glued is important. It should be appreciated that the glue used in forming the vane has no roll in the functional characteristics of the vane but rather serves only to secure the vane material to itself. This could be achieved in other manners such as by sewing, stapling or clamping.

The folded and glued web in its tubular configuration can then be transferred to a cutting mechanism **73** (FIG. **6**) to cut the web into desired lengths. One such mechanism is a conventional guillotine cutoff which may be a single-rotation-type guillotine that is spaced from the tubular web so that the folded and glued web can run through it freely and only impinges upon the vane when actual cutting occurs. The single rotation type cutter can produce any length vane **32**. After the vane is cut to length, it would be accelerated away from the guillotine cutter to where the hanger plate **36** is incorporated into the vane as by ultrasonics and subsequently forwarded for packaging or incorporation into the finished window blind product.

Another advantage to a vane **32** formed as shown in FIG. **2** is that the vane can be packaged in an almost completely collapsed state and the fabric at the rounded fold will cause the vane to rebound or open up when placed on a blind. The amount of rebound is dependent on the type of fabric used. A resilient fabric will open up fuller than a non-resilient fabric.

A first alternative embodiment of the vane of the present invention is illustrated in FIG. **7**. The vane **58** of FIG. **7** in transverse cross-section can be seen to have a flat short wall **60** and an outwardly convex long wall **62**. The structure also has a well defined permanent longitudinal crease **64** along a folded side **66**, and a tail **68** along the other side where the short wall and the long wall are adhesively joined along a bond line **70** extending the full length of the vane. The advantage to this particular structure is that due to the fact that the vane material is somewhat biased toward a flat orientation, the long wall **62** exerts a lateral biasing force on the short wall **60** at the crease **64** and along the bond line **70** so that the short wall is always biased outwardly and thus remains flat. Additionally, the short wall prevents the long wall from extending outwardly beyond the width of the short wall thus preventing the long wall from collapsing on itself. These offsetting forces between the short and long walls help the structure retain its shape when hung in a vertical orientation. The convex long wall **62** is also seen to be rounded so as to simulate a rounded pleat found in conventional draperies. The spacing between the walls **60** and **62** of the vane at the location where they are maximally spaced, as with the first described embodiment, is designated by the letter "X" in FIG. **7** and is preferably in the range of $\frac{1}{8}$ " to 1" for a vane that is $3\frac{1}{2}$ " wide.

The embodiment of FIG. **7** is also preferably formed from an elongated web or strip of fabric. The permanent longitudinal crease **64** (FIGS. **8**, **9** and **10**) is established in any conventional manner in a central region of the web. The location of the crease is in the region where the tubular vane is folded, as shown in FIGS. **8**, **9** and **10**. There is no later heat setting of the crease, so it must be made permanent. In making the crease permanent, the fibers of the fabric web

must be flattened without being cut. In the preferred embodiment of the vane, the flattening of the fibers occurs over a width of at least two times the thickness of the fabric web as best seen in FIGS. **9** and **10**. A preferred thickness of the fabric would be $10\frac{1}{2}$ mils. To achieve such a crease, a blunt creaser is used that has a contact area of at least two times the fabric thickness and compresses the fabric to about one half its normal thickness. This crease width is preferred, but the vane will function if the crease is narrower or wider.

The desire for a permanent crease as described is better understood by referring to FIGS. **9** and **10**. FIG. **10** shows a fabric web at the point of the crease **64** while FIG. **9** shows what the crease looks like when the web is folded. It is clear from this illustration that instead of gaining a sharp fold line that may tear when folded, the crease provides for a gentle fold that does not have a sharp fold line. This relatively broad, blunt crease helps the material of the vane retain its airfoil configuration by providing more of a divergent bias on the sides or sections of the web defined by the crease than would exist with a narrower crease.

A second alternative embodiment of the vane of the present invention is illustrated in FIG. **11**. The vane **74** of FIG. **11** can be seen to be very similar to the first described embodiment of FIG. **2** except that a longitudinal crease **76** is formed in the fold along the associated side **78** of the vane. The crease **76** is preferably a blunt crease as of the type described in connection with the first alternative embodiment of FIG. **7** and extends substantially along the front vane section at the longitudinal center line of a web of fabric from which the vane is made. The side **80** of the vane opposite the creased side **78** again forms a relatively thin and flat tail or rear vane section **82** where the two side edges **84** of the web are bonded together.

To obtain more rebound, a vane **86** (FIG. **12**) of the configuration shown in FIG. **2** can be modified by adding a strip **88** of resilient material longitudinally along a fold **90** on the inside of the vane **86** as illustrated in a third alternative embodiment in FIG. **12**. The resilient strip **88** can be narrow or wide. An example of a resilient strip that is suitable for use in the vane is a 50 gram/m² 6 denier latex bonded polyester typical of that used as quilt battens and found in most fabric stores. Strips of the resilient material can alternatively be bonded to the fabric transverse to the longitudinal axis of the vane. These strips, if a resilient polymer is used, will provide cross-directional strength to the vane and work to force the vane open.

The fabrics used for the first, second and third alternative embodiments of the preferred invention illustrated in FIGS. **7**, **11** and **12**, respectively, are the same as those described for the embodiment of FIG. **2**. Again, the most important attribute of the fabric is that it have diagonal, dimensional stability or memory. Another important attribute of the fabric is that it have a good hand. One particular fabric that works very well with these three embodiments is a laminate of a woven and nonwoven polyester. The methods of manufacturing the vanes are substantially the same as that for manufacturing the vane **32** of the first described embodiment.

FIGS. **13** through **15** show fourth, fifth and sixth alternate embodiments, respectively, of the vane shown in FIG. **11** but folded and creased differently. All three embodiments would again preferably be made of the same fabric as the previously described embodiments. The vane **98** shown in FIG. **13** does not have a tail, the walls **100** and **102** are symmetric with a crease **104** along a central region of the web from which the vane is formed and a bond line **106** extending the

full length of the vane is located between the side edge of one wall **100** and an internally folded flap **108** at the side edge of the other wall **102**. The general cross-sectional shape of the vane **98** is obloid. One advantage of this design is that the bonding area is hidden.

FIG. **14** represents a vane **110** that has a tail **112** defined by bonded flat legs **114** along the side edges of each wall **116** and **118** respectively. A bond line **120** extends the full length of the vane. The walls **116** and **118** are of equivalent width as are the flat legs **114**. The walls are equally bowed and terminate substantially along the longitudinal center line of the web in three longitudinally extending creases **122**, **124** and **126** which define a longitudinally extending indentation **128**. The creases bias the vane toward an open condition should it be collapsed.

FIG. **15** represents a vane **130** that has a convex short wall **132** and a convex long wall **134**. The short wall **132** is bonded or otherwise affixed to the long wall **130** with a line of adhesive **136** extending the full length of the vane at an intermediate location along the width of the long wall so as to define a single layer tail **138** along the free edge of the long wall. The opposite side edge of the vane is folded with or without a crease to define a flap **140** on the short wall that identifies the location on the short wall where it is bonded to the long wall. This embodiment improves vane closure as the tail **138** establishes a greater overlap between vanes when the vanes are in the closed position.

FIGS. **16** through **19** show seventh, eighth, ninth and tenth alternate embodiments, respectively, of the vane of the present invention. These embodiments are made from multiple webs of material instead of a single web. The embodiments all utilize a fabric with diagonal dimensional stability or memory, they all are of tubular structure, and they have a similar if not identical appearance to earlier described embodiments. The advantage to a multiple web type of structure is that it may be possible to use two webs of different colors, textures, or even different materials to create a vane. With webs of different materials, there may be differential shrinkage between the two types of materials resulting in vane bowing. Thus preshrinkage of the raw web materials prior to manufacture of the vane is desirable.

The seventh embodiment shown in FIG. **16** is a multiweb vane **150** that has a shape similar to the shape of the vane shown in FIG. **7**. This vane is made of two individual webs of materials joined together by lines of adhesive **152** extending the full length of the vane to form a substantially flat short wall **154** and a convex long wall **156** of the tubular vane. The long wall **156** is longitudinally creased inwardly at a fold **158** adjacent one longitudinal edge to define a flap **160**. The flap **160** is tucked inwardly and bonded with the adhesive **152** to the short wall **154**. The opposite edges of walls **154** and **156** are also bonded together with the adhesive **152** to form a tail **162**.

The eighth alternative embodiment shown in FIG. **17** represents a symmetrical multiweb vane **164** having internal flaps **166** defined by creases **168** adjacent opposite edges of the equal length convex walls **170** and **172** of the web. The flaps **166** are joined together with adhesive **174** extending the full length of the vane.

FIG. **18** represents a multiweb vane **176** in which a substantially flat short wall **178** is contained within a convex long wall **180** having inwardly directed flaps **182** along opposite side edges formed by creasing. The flaps **182** have an inner surface facing the short wall and the short wall is bonded to the inner surface of the flaps **182** of the long wall with adhesive **184** extending the full length of the vane.

The tenth alternative embodiment illustrated in FIG. **19** shows a multiweb vane **186** that is a variant of the vane **176** shown in FIG. **18**. The difference in the vane **186** and the vane **176** disclosed in FIG. **18** is an additional set of glue lines **188** extending the full length of the vane bonding the long wall **190** to the short wall **192** along a portion of the long wall adjacent to flaps **182** so that the short wall is bonded to the long wall on both faces of the short wall.

FIGS. **20** through **23** represent multicellular embodiments of the vane of the present invention. These vanes may include two or more cells, but it is still desirable that the fabric have diagonal dimensional stability or memory to optimize proper functioning. A cell divider may be made of the same or different materials. A cell divider may be used both to create multiple cells or to provide blackout or darkening features to the vane product. The vanes may be made using multiple webs or made using a single web and folding the web differently. The cell divider when inserted between the vane edges helps to prevent collapsing of the vane, but it does not have to be inserted between the edges. By making the cell divider from a material different than the body of the vane, it can be used to increase the bending stiffness of the vane by using a stiffer material or to enhance other physical properties such as internal light or heat reflection.

FIGS. **20** through **22** represent multicellular vanes that are folded differently but made from a single web. In FIG. **20**, a vane **202** constituting an eleventh alternative embodiment of the present invention can be seen to be formed from a single strip of material having equal length convex wall portions **204** and **206** and a flat cell divider portion **208**. The wall portion **204** and **206** define an external structure configured substantially the same as that of FIG. **11**. The cell divider portion **208** is flat and has a flap **210** at one edge, which is also one side edge of the web from which the vane is made, bonded with adhesive **212** to the internal closed end of the vane along the full length of the vane. The opposite edge of the cell divider portion which is actually a fold line **214** is bonded with adhesive **216** along a bond line extending the full length of the vane that secures the opposite edge of the cell divider portion to the two walls of the vane. The wall **204** is defined between the other side edge of the web from which the vane is made and a first creased fold line **218** while the second wall **206** is defined between the first fold line **218** and the second fold line **214**. The cell divider is then of course formed between the second fold line **214** and the flap **210**.

The twelfth alternative embodiment shown in FIG. **21** is also a multi-cellular vane **220** fabricated from a single web. The web is creased along two longitudinal fold lines **222** and **224** which are equally spaced from opposite edges **226** and **228** respectively of the web. The fold lines, however, are spaced apart from each other a greater distance than they are from each adjacent edge of the web. The vane **220** is then formed by folding the outermost sections **230** and **232** of the web (the sections between the fold lines and the outer edges of the web) in opposite directions so as to overlap on opposite sides the intermediate portion **234** of the web between the fold lines. The opposite edges **226** and **228** of the web are then bonded with adhesive **236** to the intermediate portion **234** along the full length of the vane adjacent to the longitudinal fold lines so as to form the vane as illustrated with a generally S-shaped divider **238**. It will be appreciated that the divider **238** is longer than either wall defined by the outermost sections **230** and **232** and therefore biases the walls outwardly into the desired configuration.

FIG. **22** is an illustration of the thirteenth alternative embodiment of the invention and can be seen to have an

external configuration similar to the embodiment of FIG. 17. The vane 240 is a multi-cellular vane, however, and is fabricated from one web that has four longitudinal creases. Two outermost creases 242 are spaced slightly inwardly from the longitudinal edges of the web so as to define short flaps 244. Two inner longitudinal creases 246 are equally spaced from the outer creases 242, but the spacing between the inner creases is less than the spacing between associated inner and outer creases. The flaps 244 are folded inwardly and bonded with adhesive 248 along the full length of the vane to the section of the web between the innermost creases 246 so as to form a vane having convex walls of equal length and a flat intermediate cell divider 250.

FIG. 23 shows the fourteenth alternative embodiment of the vane of the present invention, and the vane 252 can be seen to be made from three webs that are bonded together with adhesive 254. Two outermost webs are of equal width and define convex outer walls 256 of the vane. The outer walls 256 have sandwiched therebetween a shorter web or cell divider 258 that is of flat configuration with the shorter web being bonded to the outer walls with the adhesive 254 adjacent to the longitudinal edges of the web and the walls along the full length of the vane. One advantage of a multi-web construction as illustrated in FIG. 23 is that different fabrics or films may be used in the construction of the vane. For example, the vane may have as its cell divider 258 a sheet of metalized polyester film that gives the product room-darkening capabilities. Because the walls 256 of the vane are of equal width, i.e. symmetric, the different material characteristics will not affect vane bowing. Thus, blackout materials, insulating materials or sound-deadening materials may be added to the vane construction without an adverse affect on vane performance.

A fifteenth alternative embodiment of the invention is illustrated in FIG. 24 and can be seen to be made from two webs bonded together with adhesive 262 along the full length of the vane. The webs are joined so as to define a convex long wall 264 and a flat short wall 266 with relatively thin tails 268 defined at the side edges of the webs where they are bonded together. The convex curvature of the long wall 264 advantageously tends to keep the short wall 266 taught and flat.

FIG. 25 illustrates a sixteenth alternative embodiment of the invention. In this embodiment a single web or strip of material is folded and creased at 272 substantially along a longitudinal centerline and the two halves of the web defined on either side of the crease 272 are formed into S-shaped configured walls 274 and 276 which are interconnected as by bonding with adhesive along the contiguous side edges 278 and along a mid line 280 between each side edge 278 and the crease 272. A curved vane 282 that is also S-shaped in configuration is thereby formed with two crescent shaped cells 284.

It will be appreciated that the vane shape, number of cells and number of webs or strips used to manufacture a vane can vary. The two most important features of the vane, however, remain that it be tubular in construction, i.e., it be hollow in one or more of its cells, and that the vane preferably be made of a fabric or a material that has diagonal dimensional stability even though materials having diagonal dimensional memory would also work satisfactorily. The spacing between the outer walls for any of the alternative embodiments is preferably in the range of $\frac{1}{8}$ " to 1" at their maximum displacement.

To illustrate the advantages gained by producing vanes in a tubular configuration as described hereinabove and from

materials having diagonal, dimensional stability or memory, the results of tests comparing standard typical vanes found in the art with those of the present invention are presented in FIGS. 26 and 28.

For purposes of the tests from which the data was obtained, the vanes were cut to be 84 inches in length and 3.5 inches wide. The vanes were suspended from the top edge with centrally located clips approximately $\frac{3}{8}$ inch in width and measurements were made to determine the force that had to be applied at the opposite lower free bottom edge of the vane to twist the opposite or bottom edge of the vane through varying degrees. This force is referred to herein as the torque index.

The first test compared a single-ply and double-ply planar prior art type vane to a tubular vane made in accordance with FIG. 7 of the present invention wherein the vanes were all made from a 100 gram/m² acrylic bonded polyester spun bond nonwoven fabric manufactured by Unitika Corporation of Japan. The test results are shown in FIG. 26. The amount of force required to twist the lower edge of the vanes through the designated number of degrees is recorded in the three tables of FIG. 26. It will there be seen that the force required to rotate a non-tubular, single-ply fabric vane through 45 degrees, for example, is approximately 1.5 grams. The force required to rotate a non-tubular, 2-ply fabric vane through 45 degrees is slightly more than 1.5 grams. In contrast, the force required to rotate a tubular vane constructed in accordance with the present invention through 45 degrees is 59 grams, therefore illustrating the vastly improved resistance to torque obtained by a tubular vane constructed in accordance with the present invention. A graph illustrating the comparative data set forth in FIG. 26 is shown in FIG. 27.

The advantages obtained from utilizing material having diagonal, dimensional stability relative to material that does not have such stability is illustrated in data presented in FIG. 28. FIG. 28 has two tables, one directed to a tubular vane configured as shown in FIG. 7 made of a woven fabric and specifically a woven slub polyester, which fabric does not have diagonal, dimensional stability or memory and an identically configured tubular vane made of a polyester knit fabric, that does have diagonal dimensional stability. Both fabrics were of equal weight.

In looking at the tabular information in FIG. 28, it will be appreciated that the force required to rotate a woven fabric tubular vane without diagonal, dimensional stability or memory through 45 degrees is just less than 2 grams of force. On the other hand, the force required to rotate a tubular knit fabric vane having diagonal, dimensional stability through 45 degrees is 26 grams. Accordingly, a dramatic difference in force necessary to rotate the vane through 45 degrees is illustrated showing that materials having diagonal, dimensional stability are far preferable for use in a vane. A graph illustrating the comparison between the knit fabric having diagonal, dimensional stability and a woven fabric not having such stability is illustrated in FIG. 29.

It will be appreciated from the above information that the structural configuration of the vane and the fabric from which it is made have a significant bearing on the vanes torsional resistance to twisting. While the torque index of the vane may have varying importance to a manufacturer or consumer, applicant has found vanes to be desirable that have a torque index in excess of 10 grams for 45 degrees of rotation when the vanes are 84 inches in length and 3.5 inches wide.

While the present invention has been disclosed in connection with a preferred embodiment thereof and several

15

alternate embodiments, it should be understood that there may be many other embodiments which fall within the spirit and scope of the invention as defined by the following claims.

What is claimed is:

1. A covering for an architectural opening comprising in combination a control system and a plurality of vanes suspended vertically from the control system, each of said vanes comprising an elongated, flexible, hollow, tubular body having opposing first and second walls being joined adjacent longitudinal edges of said vane at least one of side walls is outwardly convex and wherein said vanes are interconnected to each other solely through said control system.

2. The covering of claim 1 wherein said vanes are made of a nonwoven fabric.

3. The covering of claim 1 wherein said vanes are made of a knit material.

4. The covering of claim 1 wherein said vanes are made of a material that is a laminate including at least one layer of fabric that is diagonally, dimensionally stable.

5. The covering of claim 1 wherein said vanes have a top edge and a bottom edge and wherein 10 grams or more of force are required to twist the bottom edge of the vertically extending vane that is suspended from its top edge when the vane is eighty-four inches in length and three and one-half inches wide.

6. The covering of claim 1 wherein said tubular body is formed from two interconnected strips of material defining said first and second walls of said body, each wall of said body having longitudinally extending side edges being proximate to the associated side edges of the other wall.

7. The covering of claim 6 wherein one side edge of one of said walls is folded back onto said one wall to define a longitudinally extending flap and wherein said flap is secured to the associated side edge of the other wall of said body.

8. The covering of claim 6 wherein each side edge is folded back onto the associated wall of said body to form a longitudinally extending flap and wherein the flaps on one wall are secured to the flaps of the other wall.

9. The vane of claim 6 wherein the side edges of one of said walls are folded back onto said one wall to form longitudinally extending flaps and wherein said flaps are secured to the associated side edges of the other wall.

10. The covering of claim 9 wherein said other wall is flat and said one wall is longer than said other wall and said one wall is convex outwardly.

11. The covering of claim 9 wherein said flaps have an inner surface facing the associated wall of said body and wherein said flap is secured to said side edges of the other wall along said inner surface.

12. The covering of claim 9 wherein said side edges of said other wall are further secured to a portion of said one wall adjacent to the associated flap.

13. The covering of claim 1 wherein said hollow tubular body has a longitudinally extending fold.

14. The covering of claim 13 wherein said fold is a crease.

15. The covering of claim 14 wherein said crease is formed in an inner surface of said tubular body by compressing the material of said vane over an area that is approximately twice the thickness of the fabric.

16. The covering of claim 13 wherein said vanes are formed from an elongated strip of material having two longitudinally extending side edges, said side edges extending proximate to each other.

17. A covering for an architectural opening comprising in combination a control system and a plurality of vanes

16

suspended vertically from said control system, said vanes each being comprised solely of an elongated, hollow, tubular body having first and second walls at least one of which is outwardly convex, said body being formed from a flexible material that has diagonal, dimensional memory and wherein said vanes are interconnected to of each other solely through said control system.

18. The covering of claim 17 wherein said hollow tubular body has a longitudinally extending fold.

19. The covering of claim 18 wherein said vanes are formed from an elongated strip of said material having two longitudinally extending side edges, said side edges extending proximate to each other.

20. The covering of claim 16 or 19 wherein said side edges are immediately adjacent to each other.

21. The covering of claim 16 or 19 wherein said side edges are displaced relative to each other so as to define a single layer tail along one side edge.

22. The covering of claim 16 or 19 wherein one of said side edges is folded longitudinally back upon the strip to define an elongated flap along the associated side edge, said flap being secured to the other side edge.

23. The covering of claim 13 or 18 further including three longitudinally extending creases along said fold, so as to define a longitudinally extending indentation along said fold.

24. The covering of claim 13 or 18 further including at least one strip of resilient reinforcing material bonded to said body in the hollow interior along said fold.

25. The covering of claim 24 wherein said reinforcing material extends longitudinally of the vane.

26. The covering of claim 24 wherein there are a plurality of said strips of reinforcing material which extend transversely of the vane.

27. The covering of claim 13 or 18 wherein the piece of material from which each vane is an elongated strip having elongated first and second side edges, a first fold spaced from said first side edge and a second fold equally spaced from said second side edge, and wherein said first side edge is secured to a portion of said strip proximate said second fold and said second side edge is secured to a portion of said strip proximate said first fold so as to define a longitudinally extending divider portion of said strip dividing the tubular body into two cells.

28. The covering of claim 27 wherein the spacing between said fold lines is greater than the spacing between each fold line and the associated side edge of the strip so that said divider is generally S-shaped in cross-section.

29. The covering of claim 27 wherein each side edge is folded back onto said strip to define longitudinally extending first and second flaps along said first and second side edges respectively and wherein said first flap is secured to said strip proximate said second fold and said second flap is secured to said strip proximate said first fold.

30. The covering of claim 29 wherein said folds are spaced apart a shorter distance than their spacing from the associated side edge such that said divider is flat.

31. The covering of claim 13 or 18 wherein the piece of material from which each vane is constructed is an elongated strip having elongated first and second side edges and first and second elongated folds, said second side edge being folded back along a third fold onto said material to form an elongated flap along said second side edge, and wherein said first fold is equally spaced from said first side edge and said second fold and wherein said first side edge is positioned proximate said second fold and is secured to said strip proximate said second fold such that the portion of said strip

17

between said second fold and said second side edge forms a divider of said tubular body dividing said body into two cells, said flap being secured to said strip internally of said tubular body.

32. The covering of claim **31** wherein said divider is flat, and wherein the strip between said first side edge and said first fold is outwardly convex and between said folds is outwardly convex.

18

33. The covering of claim **13** or **19** wherein said fold is rounded.

34. The covering of claim **13**, **16**, **18**, or **19** wherein said vanes are formed from a strip of material that is a laminate.

35. The covering of claim **16** or **19** wherein said side edges are bonded together.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 6,170,552 B1
DATED : January 9, 2001
INVENTOR(S) : Wendell B. Colson et al.

Page 1 of 1

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Title page,

Item [75], Inventors, please replace Item [75] with the following:

-- [75] Inventors: **Wendell B. Colson; Paul G. Swiszczy**, both of Boulder, CO (US);
Jason T. Throne, Steamboat Springs, CO (US) --

Signed and Sealed this

Fourth Day of February, 2003

A handwritten signature in black ink, appearing to read "James E. Rogan", with a horizontal line underneath it.

JAMES E. ROGAN
Director of the United States Patent and Trademark Office